Stuttgarter Beiträge zur Naturkunde
Serie A (Biologie)

Herausgeber:

Staatliches Museum für Naturkunde, Rosenstein 1, D-70191 Stuttgart

Stuttgarter Beitr. Naturk.	Ser. A	Nr. 621	34 S.	Stuttgart, 1. 6. 2001

The Life Cycle of *Lemanniella minotauri* n. sp. and the Erection of the New Family Lemanniellidae (Acari: Astigmata)

By Eberhard Wurst, Stuttgart

With 76 figures and 1 table

Summary

All instars of *Lemanniella minotauri* **n. sp.** are described from nests of the ant *Lasius brunneus* (Hymenoptera: Formicidae) in central Europe. This is the first time non-hypopal instars of the genus *Lemanniella* are described. The mites feed on an unidentified fungus growing on the wood in the nest. Because of the exceptional body shape, peculiarities in setation, and the behaviour it is proposed to remove the genus *Lemanniella* from the Acaridae and to establish the **new family** Lemanniellidae.

Zusammenfassung

Sämtliche Entwicklungsstadien von *Lemanniella minotauri* **n. sp.** werden aus Nestern der Ameise *Lasius brunneus* (Hymenoptera: Formicidae) beschrieben. Erstmals werden damit nicht-hypopiale Stadien dieser Gattung vorgestellt. Die Milben ernähren sich von einem nicht identifizierten Pilz, der auf dem Holz im Ameisennest wächst. Aufgrund der außergewöhnlichen Körperform, Besonderheiten der Borstenkonfiguration und dem Verhalten der Milben wird vorgeschlagen, für die Gattung *Lemanniella,* die bisher in die Acaridae gestellt wurde, die **neue Familie** Lemanniellidae einzurichten.

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1. Introduction

Ants' nests serve as habitats for a considerable number of mite species. Most of these species are adapted to and depend on one or only a few ant species. Among the myrmecophilous astigmatic mites are some unusual forms with a hitherto enigmatic systematic position. An example is *Myrmolichus greimae* occurring in the nests of the palearctic ant *Lasius fuliginosus* and feeding on the fungus *Cladosporium myrmecophilum* (TÜRK & TÜRK 1957) which is cultivated by the ants and reinforces the carton nest material (SEIFERT 1996).

Another representative of the Astigmata exhibiting an unusual morphology was described by MAHUNKA (1977) from deutonymphs having been collected from ants of the species *Myrmica sabuleti* in Switzerland. The exceptional morphology of the new deutonymphs prompted MAHUNKA (1977) to establish the new genus *Lemanniella* (after the Latin name of the Lake Geneva, Lacus Lemannus). MAHUNKA (1977) named the new mite species *L. reducta,* the species name apparently referring to the reduction of numerous characters (e.g. palposoma, leg setae) in the deutonymph. MAHUNKA (1977) included the genus *Lemanniella* in the Acaridae but he added the remark "that his very specialized form adopts a very isolated position within the family Acaridae".

Since then nothing was added to our knowledge of *Lemanniella.* In the course of examinations of wooden nest materials of ants in central Europe over the last ten years I succeeded in elucidating the complete life cycle of another species of the genus *Lemanniella* occurring in the nests of the ant *Lasius brunneus.*

This paper describes the new *Lemanniella* species and for the first time presents non-hypopal instars of this genus. First observations on the biology of the new species are reported. Because of the exceptional body shape, peculiarities in setation, and the behaviour I propose to remove the genus *Lemanniella* from the Acaridae and to establish a new family for this aberrant astigmatic mite genus.

2. Materials, Methods and Acknowledgements

2.1. Materials

Material from ants' nests in fallen or logged trees was collected. Localities where mites and ants were taken are the following (all materials were collected by E. WURST):

Germany – 25. 03. 90. Untermberg near Bietigheim-Bissingen (south-west Germany); in a wood nest of *Lasius brunneus.* – 09. 02. 95. Pasture at Korntal-Münchingen (near Stuttgart, south-west Germany); in a wood nest of *Lasius brunneus.* – 08. 04. 00 Garden between Unterriexingen and Oberriexingen (near Bietigheim-Bissingen, south-west Germany); in a wood nest of *Lasius brunneus.*

Austria – 26. 02. 98 Vienna, Wienerwald between Leopoldsberg and Kahlenberg (Josefinenhütte); in an abandoned wood nest of an unidentified ant.

Fig. 1. *Lemanniella minotauri* n. sp., male; lateral view. – Scale bar: 20 µm.

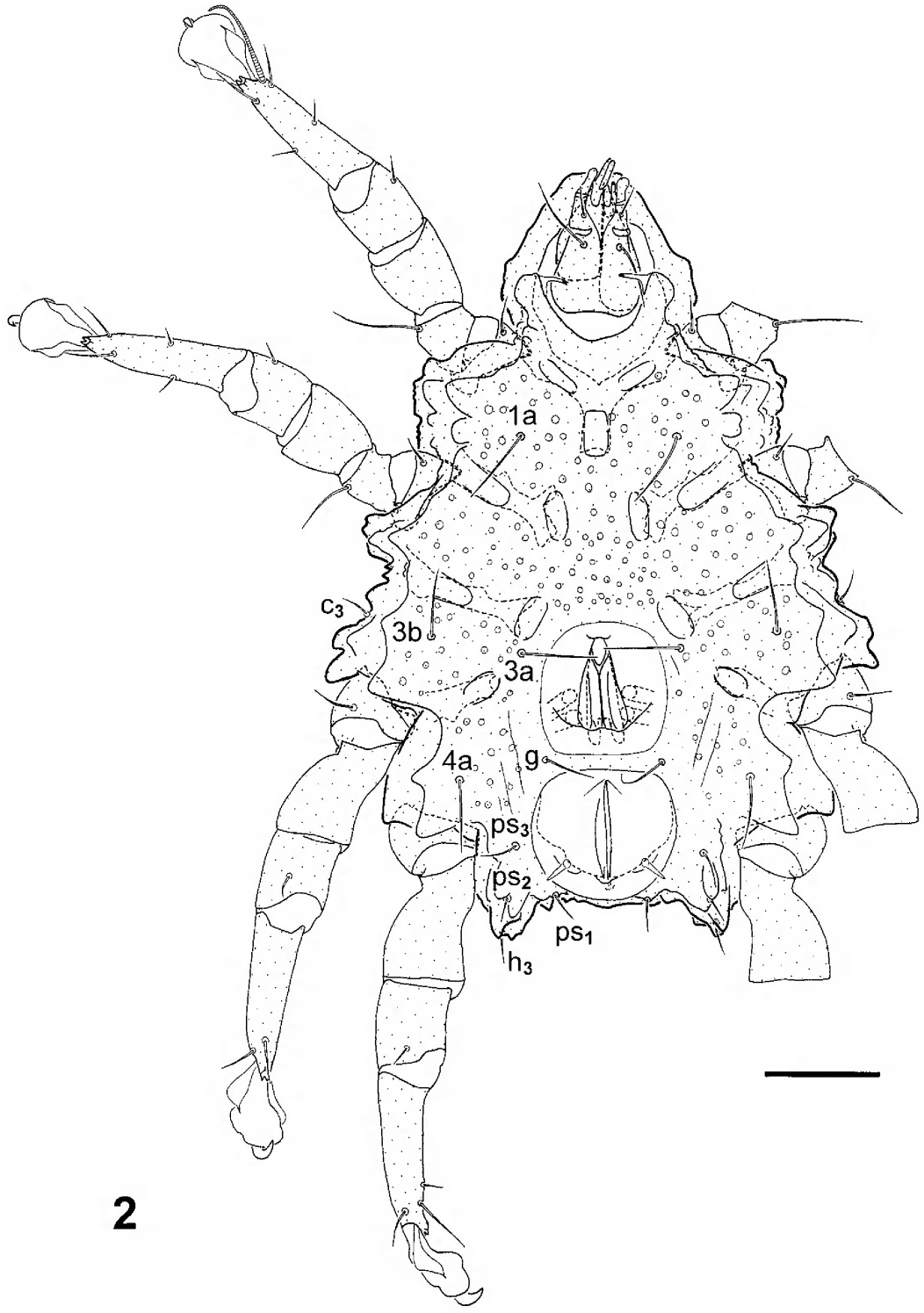


Fig. 2. *Lemanniella minotauri* n. sp., male; ventral view, left legs partly omitted. – Scale bar: 25 µm.

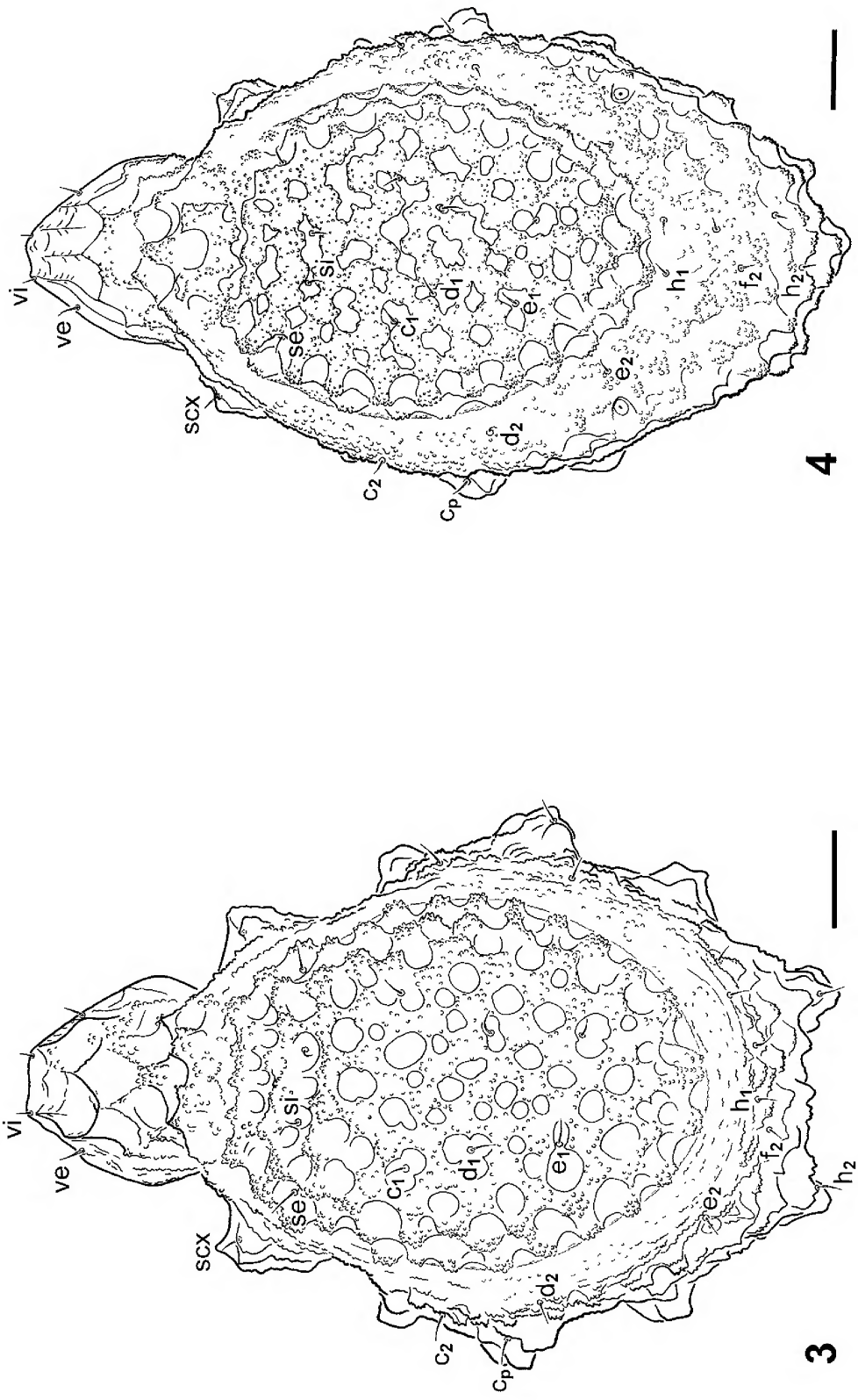


Fig. 3–4. *Lemanniella minotauri* n. sp. – 3. Male; idiosoma, dorsal view (scale bar: 20 µm); – 4. female; idiosoma, dorsal view (scale bar: 20 µm).

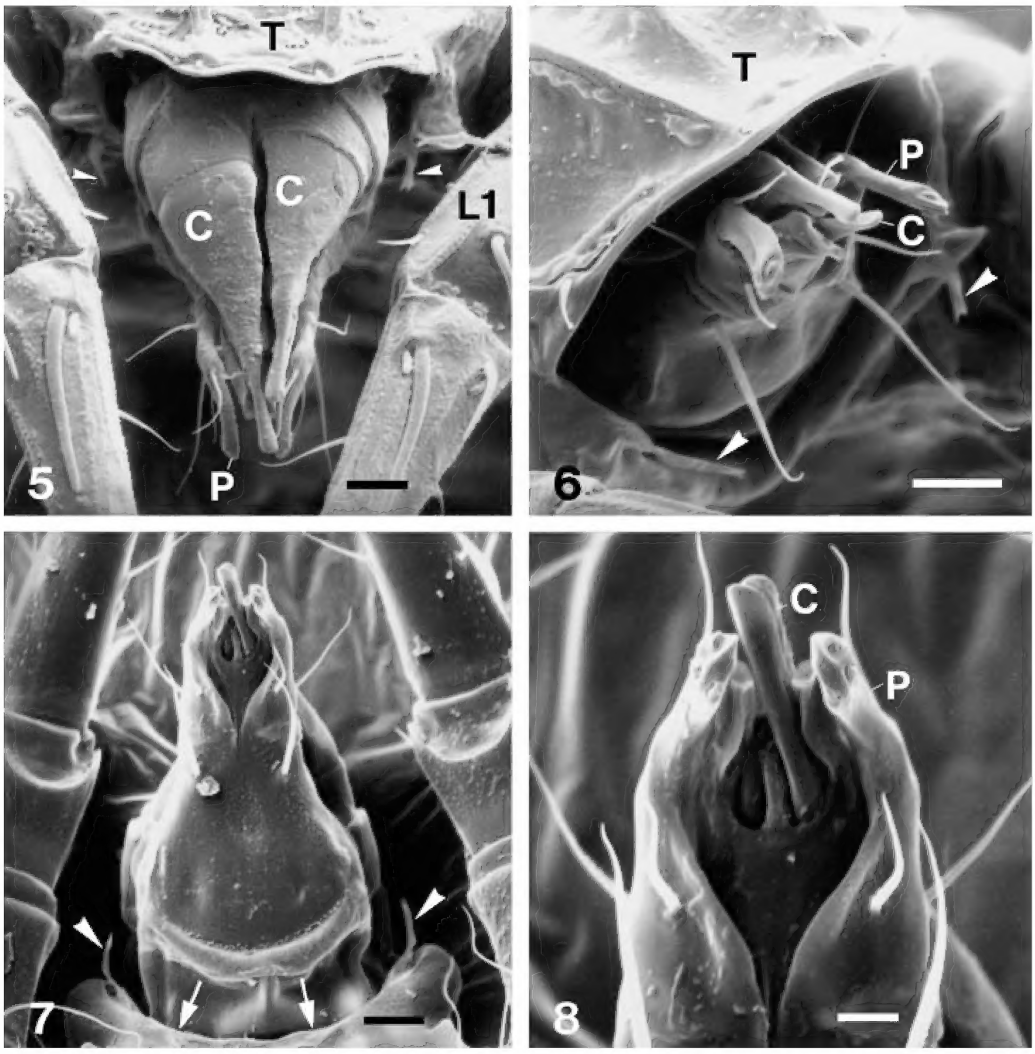


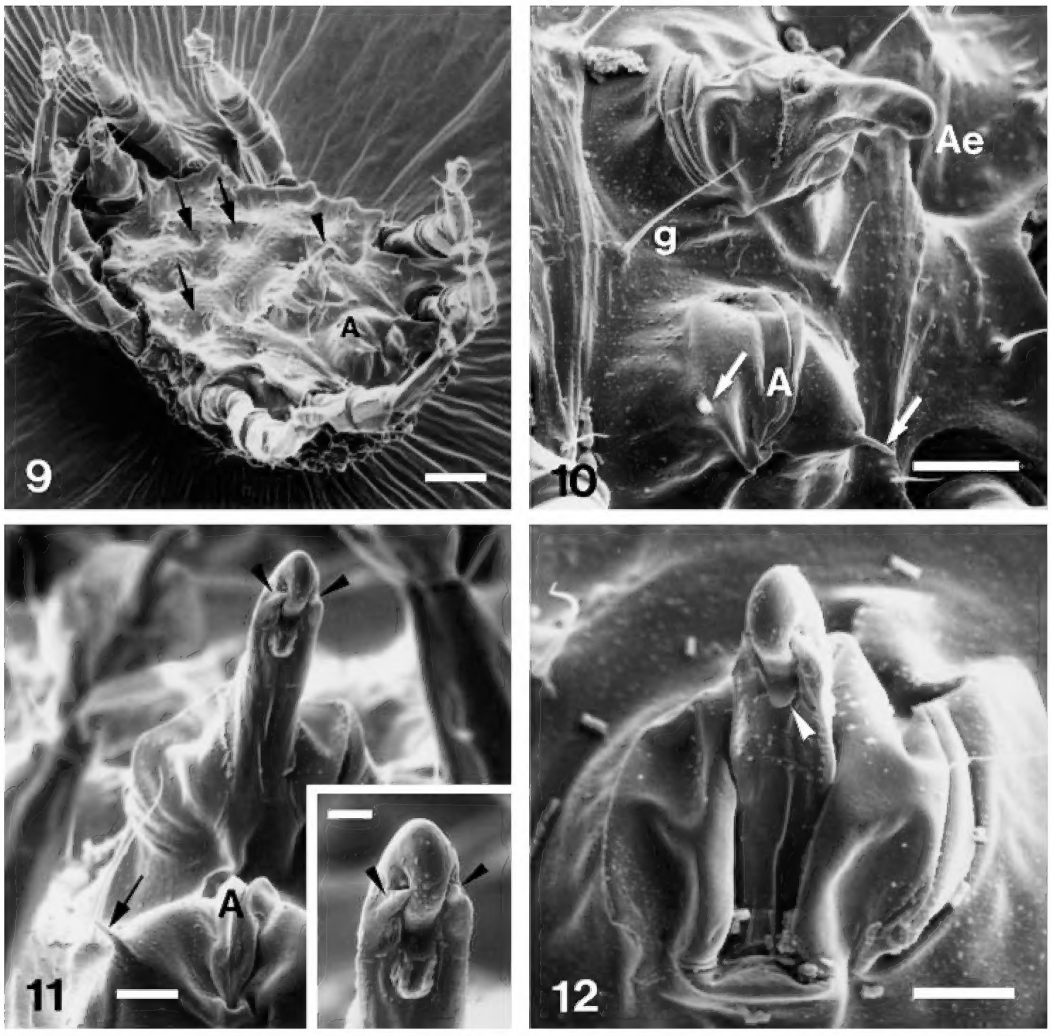
Fig. 5–8. *Lemanniella minotauri* n. sp., male. – 5. Gnathosoma, frontal view; *C* = chelicera, *L1* = leg I, *P* = palp, *T* = tegmen, *arrowheads:* bifurcate elongations apparently constituting Grandjean's organ (scale bar: 5 µm). – 6. Gnathosoma, lateral view; *C* = chelicera, *P* = palp, *T* = tegmen, *arrowheads:* bifurcate elongations apparently constituting Grandjean's organ (scale bar: 5 µm). – 7. Gnathosoma, ventral view; *arrows* point at the collar surrounding the basis of the gnathosoma posteriorly. Further *explication: arrowheads:* bifurcate elongations apparently constituting Grandjean's organ (scale bar: 5 µm). – 8. Gnathosoma, ventral view, detail of Fig. 7; *C* = chelicera, *P* = palp (scale bar: 2 µm).

2.2. Methods

The nest material was inspected by means of a stereo microscope (magnifications 16x and 40x) after breaking down the nest material into small pieces.

If present in the nest material, ants were killed and examined for attached phoretic deutonymphs.

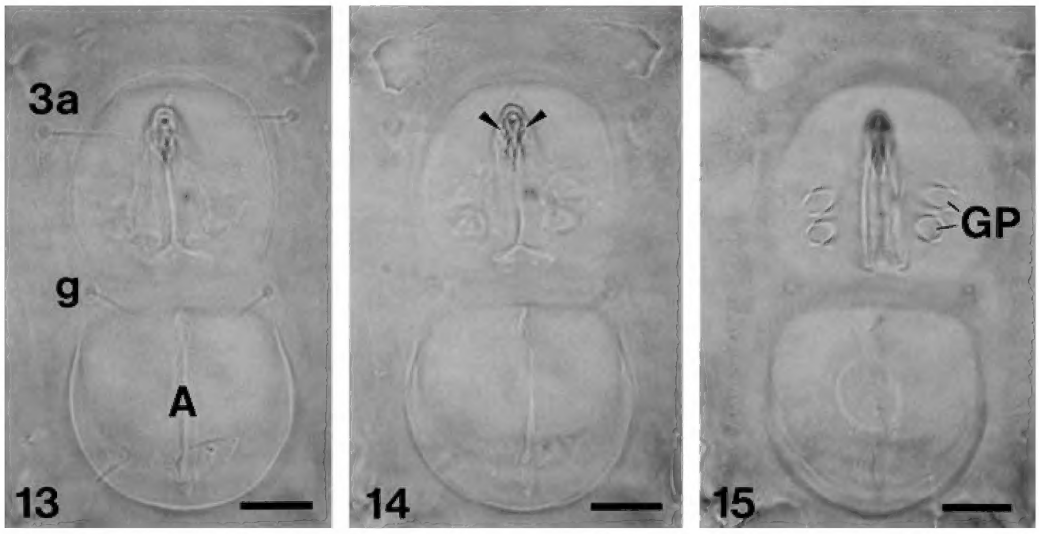
For all nest samples containing ants, about 30 ant specimens were killed and preserved in 70 % ethanol for later identification of the species. The ants carrying phoretic deutonymphs were equally preserved in alcohol.



Figs. 9–12. *Lemanniella minotauri* n. sp., male. – 9. Ventral view. Note the depressions (*arrows*) in the body wall and the small bumps covering the surface. Further *explications: A* = anal region, *arrowhead:* protruded aedeagus (scale bar: 20 µm). – 10. Genital and anal region of specimen shown in Fig. 9. Note the soft cuticle around the anal slit (*A*) which can be inflated. Further *explications: Ae* = aedeagus, g: seta, *arrow*: spike-like lappet (scale bar: 10 µm). – 11. Protruded aedeagus of Fig. 10 in frontal view. The tip of the aedeagus is bent back and terminates in a shape like a duck bill (scale bar: 5 µm). Inset: tip of aedeagus in higher magnification (scale bar: 2 µm). *Arrowheads* point at the spike-like structures. Further *explication: A* = anal slit, *arrow*: spike-like lappet. – 12. Protruded aedeagus of another male but from the same population (Wienerwald, Austria) showing its duck bill shaped termination (*arrowhead*) (scale bar: 5 µm).

From all localities mites were prepared for light microscopy. In order to clarify which instars belong to the same species, mites in moulting torpor were separated just before hatching and prepared for microscopic examination. Eggs in different phases of development (after formation of the prelarva and after formation of the larva, but before hatching) were equally dealt with.

For light microscopy, the mites were mounted in Hoyer's fluid. Drawings were made with a Zeiss drawing apparatus. Light micrographs were produced by using the Zeiss photomicroscope "Axiophot".



Figs. 13–15. *Lemanniella minotauri* n. sp., male; optical sections (light micrographs) of different focal planes taken through genital and anal region. Note the borderline of the soft-walled regions, especially the pillow-like appearance of the anal region. – 13. Superficial plane; *A* = analt slit, *3a, g*: setae; – 14. middle plane; *arrowheads* point at the spike-like structures (see Figs. 11 and 12); – 15. deepest plane; *GP* = genital papillae. – Scale bars: 10 µm.

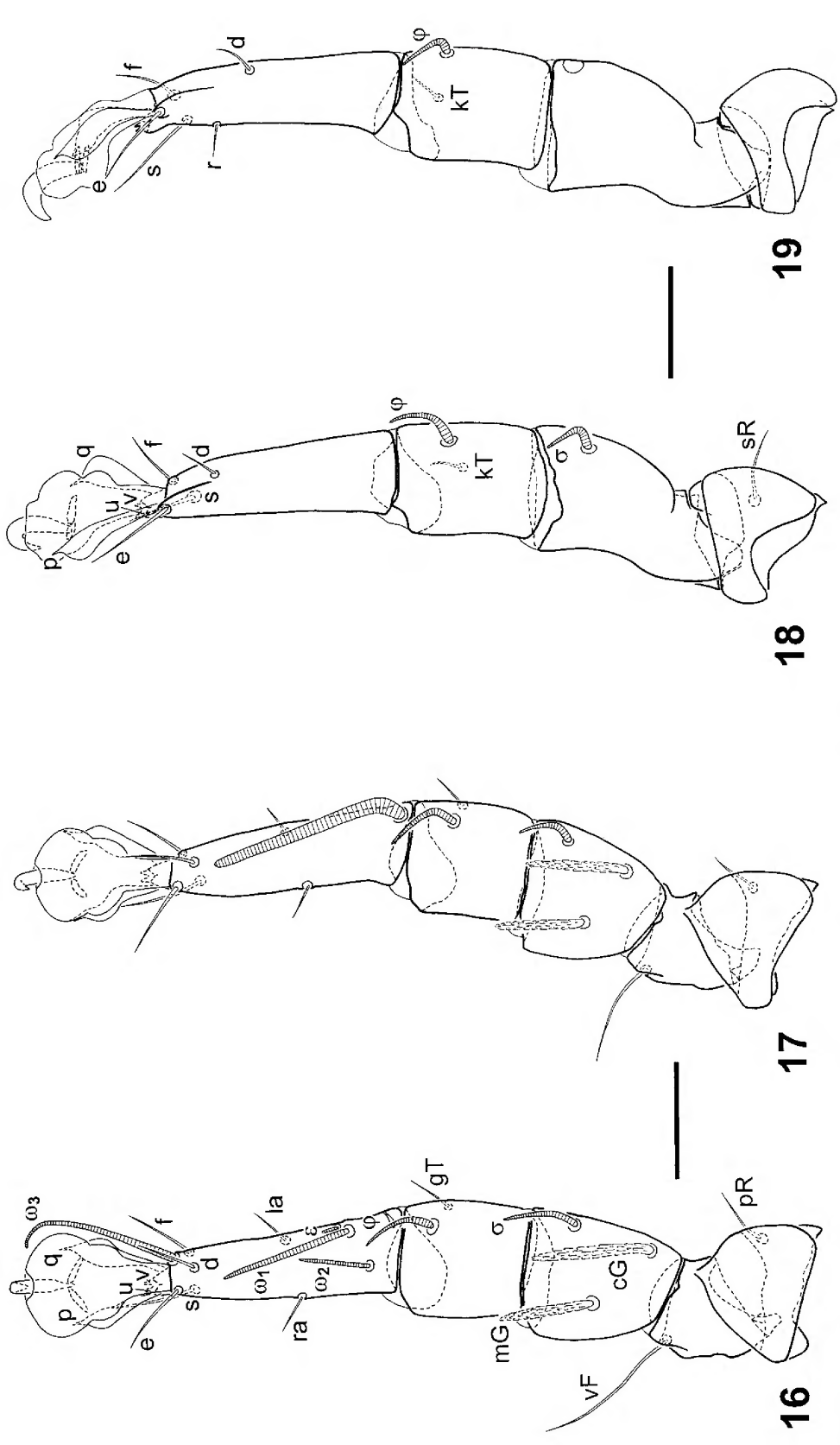
For scanning electron microscope (SEM) investigations, the mites were killed by freezing and were cleaned by washing with a surfactant. Further preparation was performed after Bock (1987) in five steps: 1) fixation by a modified Carnoy (acetic acid : chloroforme : ethanol = 1 : 1 : 3) for at least 4 hrs, 2) ethanol (5–10 min), 3) hexamethyldisilazane (5 min), 4) air-drying, 5) sputtering with gold. A few ants with attached deutonymphs were fixed without prior washing in order to guarantee that the mites maintain their position. The mites and the mite loaded ants were examined by using the SEM DSM 940 (Zeiss).

The species concept follows the "biological species concept" sensu Mayr (1963). The nomenclature of idiosomal chaetotaxy follows Griffiths et alii (1990), the nomenclature of leg chaetotaxy is according to Grandjean (1939).

2.3. Acknowledgements

The first complete description of a mite of the genus *Lemanniella* was made possible by financial support of the "Stiftung Natur und Umwelt" of the Landesbank Baden-Württemberg (Stuttgart).

For their most generous help I thank the following persons: Prof. Dr. Brigitte Frank (Stuttgart) and Prof. Dr. A. Fain (Brussels) supported this study from its beginning. I am grateful to Prof. Dr. B. M. OConnor (Ann Arbor) for discussions on the taxonomic status of *Lemanniella*. Dr. K.-F. Raqué (Heidelberg), Dr. B. Seifert (Görlitz), and D. Veile (Obersulm) determinated the species identity of the ants and gave expert advice about the builders of the nest materials. I also thank B. Curth and E. Rücker (Stuttgart) for assistance in the SEM preparations. Dr. F. Woog (Stuttgart) critically read the manuscript and gave valuable comments.



Figs. 16–19. *Lemanniella minotauri* n. sp., male. – 16. Leg I; – 17. leg II (scale bar Figs. 16–17: 15 µm); – 18. leg III; – 19. leg IV (scale bar Figs. 18–19: 15 µm). – Legs are shown in dorsal view.

3. Lemanniellidae n. fam.

Type genus: *Lemanniella* Mahunka, 1977.

3.1. Definition

3.1.1. Non-hypopal instars

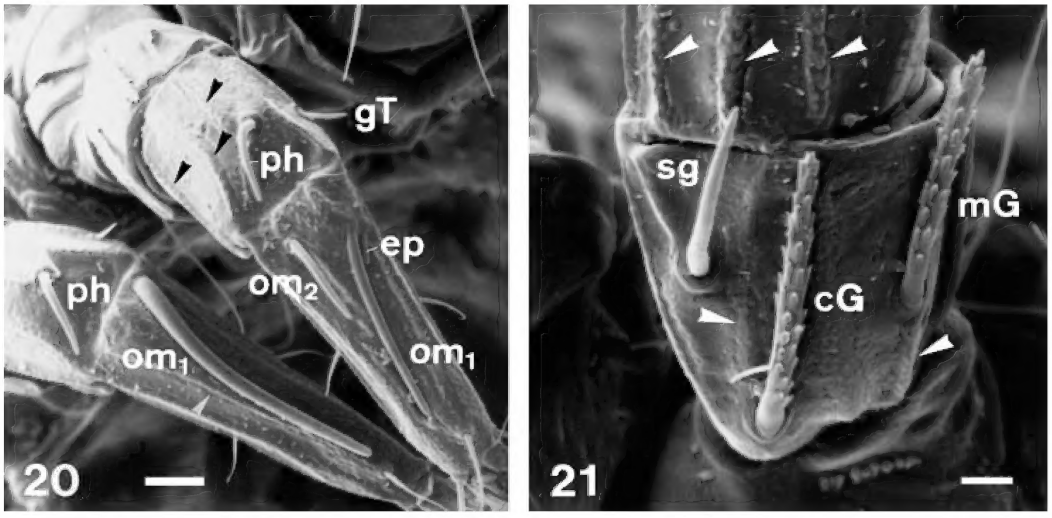
Dorsum without sejugal furrow. Adults with a dome-shaped elevation delimited laterally and posteriorly by a band of cuticle decorated with tiny tubercles. Entire dorsum of adults of honeycomb appearance, conspicuously regular on the dome, irregular in front of it and beneath the band. Dorsum of non-hypopal juvenile instars covered with mushroom-like protuberances with a jagged cap. Ventral body wall of all non-hypopal instars with depressions. Femur and genu of leg III and IV fused in all non-hypopal instars. Pretarsi with pronounced ambulacrum and strong claw. Setae p and q foliate in all legs. Males lack adanal suckers and sucker-like setae on leg IV. Retroconjugate mating mode.

3.1.2. Deutonymph

Palposoma absent. Scapular setae lacking. Setae 1a, 3a, 3b, 4a reduced (only the sockets are present). Genital opening integrated into the sucker plate. Tarsus I and II with weak claw and five (leg I) and six (leg II) setae. Solenidion sigma of genu I and II reduced (only the sockets are present). Leg III and IV without claw and solenidia. Tibia and tarsus of leg III and IV fused.

3.2. Remarks

Since our knowledge on *Lemanniella* is based on the life cycle of only one species, the family definition necessarily has to be provisonal.



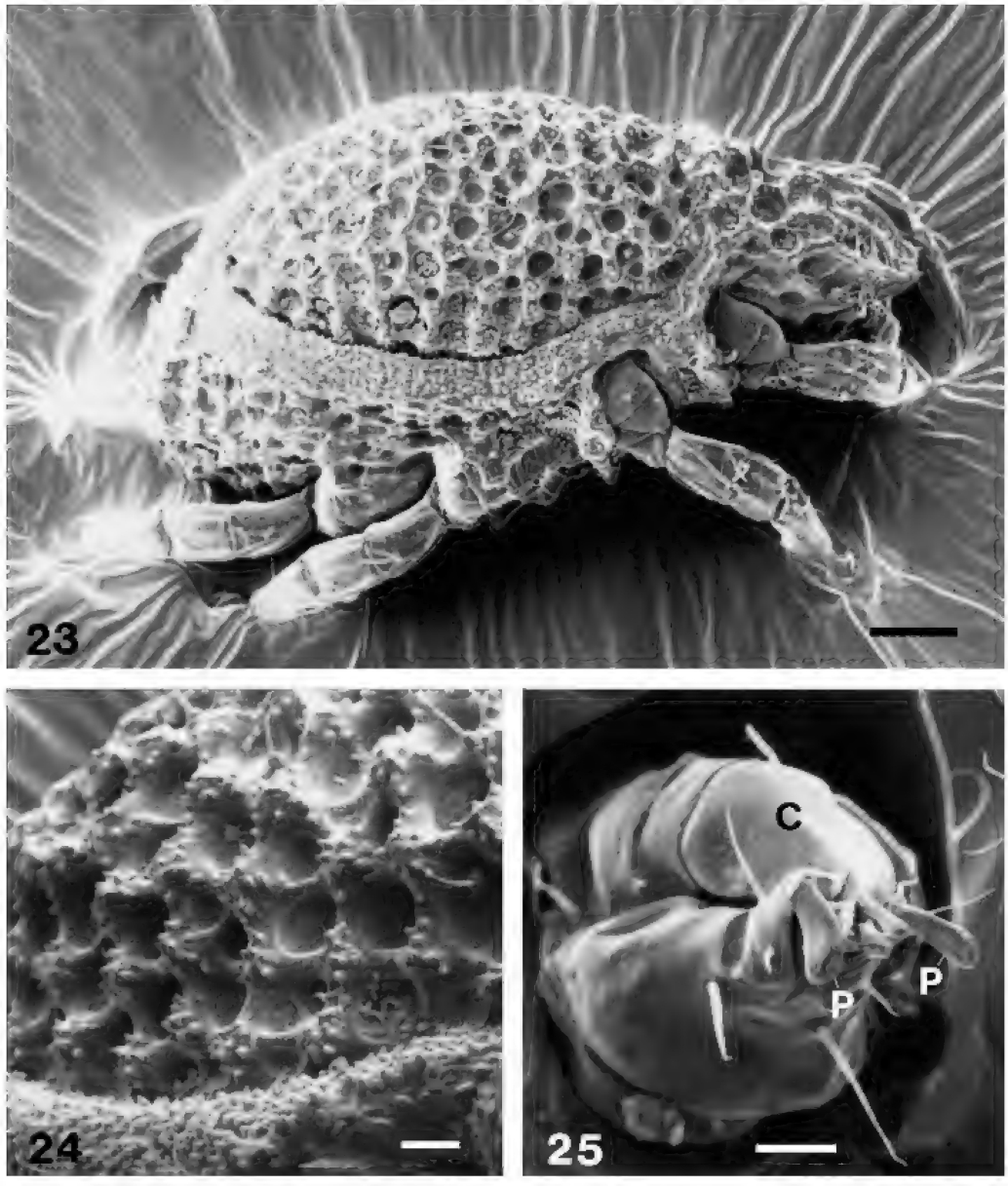
Figs. 20–21. *Lemanniella minotauri* n. sp., male. – 20. Right leg I (above) and leg II (below) in dorsal view showing the arrangement of setae and the granulated ridges (*arrowheads*) on the surface of the legs. Further *explications:* om_1 = solenidion omega 1, om_2 = solenidion omega 2, *ph* = solenidion phi of tibia, *ep* = famulus epsilon, *gT*: seta (scale bar: 5 µm). – 21. Right leg I in dorsal view showing solenidion sigma (*sg*) and pectinate setae *cG* and *mG* of genu. Again note the granulated ridges (*arrows*) (scale bar: 2 µm).

Fig. 22. *Lemanniella minotauri* n. sp., female; ventral view, left legs partly omitted. – Scale bar: 25 µm.

A definition of non-hypopal instars for the genus *Lemanniella* is not given because our knowledge is at present restricted to only one species.

4. Description of *Lemanniella minotauri* n. sp.

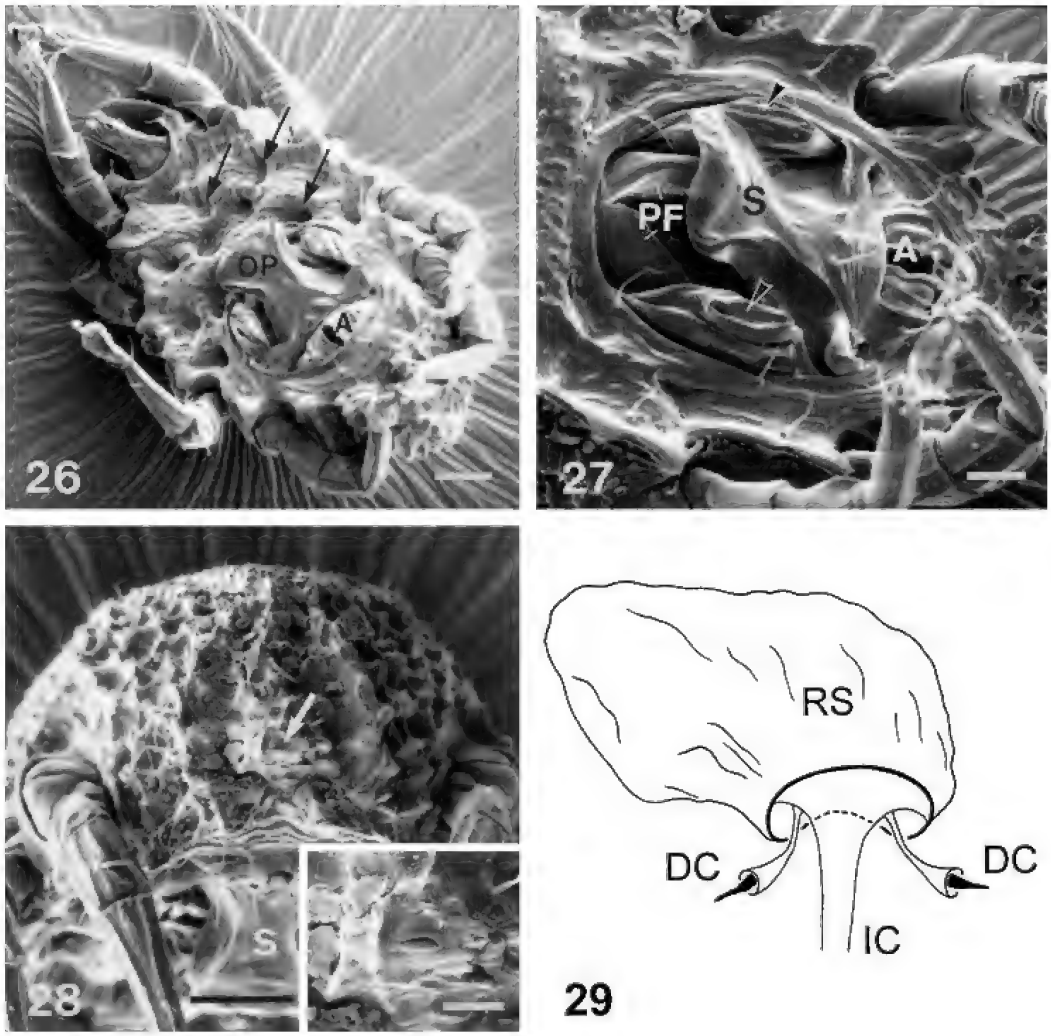
Deposition of holotype: Holotype ♂ from the population from Wienerwald (Austria) is deposited in the Zoologisches Museum Hamburg.



Figs. 23–25. *Lemanniella minotauri* n. sp., female. – 23. Female in lateral view (scale bar: 20 µm). – 24. Detail of the dome-shaped dorsal elevation and the band covered with tiny tubercles. The elevation has a honeycomb structure, the ridges surrounding the pores are decorated with small tubercles (scale bar: 5 µm). – 25. Gnathosoma, frontal view; *C* = chelicera, *P* = palp (scale bar: 5 µm).

Paratypes representing all instars are deposited in the following institutions: Zoologisches Museum Hamburg (Germany), National History Museum London (Great Britain), Institut royal des Sciences naturelles de Belgique (Brussels), Museum of Zoology, The University of Michigan, Ann Arbor (USA), Zoological Institute, Russian Academy of Sciences, St. Petersburg (Russia).

Etymology: From Minotaurus, the monster that lived in the labyrinth in Crete according to Greek mythology because the nest structure reminds one of a three-dimensional labyrinth.



Figs. 26–29. *Lemanniella minotauri* n. sp., female. – 26. Female in ventral view. Note the depressions (*arrows*) in the body wall and the small bumps covering the surface. Further *explications: A* = anal region, *OP* = slightly lifted trapdoor-like shield that closes the oviporus (scale bar: 20 µm). – 27. Genitoanal region with partly opened oviporus. The trapdoor-like shield (*S*) is slightly lifted and allows a view on the paragynial folds (*PF*) underneath. *Arrowheads* point at the pouches containing the genital papillae. Further *explication: A* = anal slit (scale bar: 10 µm). – 28. Opisthosoma showing the bursa copulatrix (*arrow,* inset). Further *explications: S* = trapdoor-like shield (scale bar: 20 µm, scale bar inset: 5 µm). – 29. Receptaculum seminis and appendages; *DC* = ductus conjunctivus, *IC* = inseminatory canal, *RS* = sac of receptaculum seminis.

Differential diagnosis: At the date of publishing *Lemanniella minotauri* can be distinguished from the only other known species *L. reducta* only by differences in the characters of the deutonymphs. The most prominent differences are 1) the enormous length of solenidion omega 3 in *L. reducta* and 2) the shape of seta e in leg II which is formed as a spoonlike adhesive seta in *L. reducta* whereas in *L. minotauri* it is reduced to a short spine.

Description: Retroconjugate mites with facultative hypopody. All instars occur in nests of the ant *Lasius brunneus.* All idiosomal setae smooth. All non-hypopal instars share the following characters: legs bear their normal number of solenidia on tarsi, setae u and v in all legs short spines (Fig. 35), setae p and q partly fused with the pretarsus (Figs. 34–35), tibia I and II with one smooth seta (gT) and solenidion phi (Fig. 20), genu I and II with two pectinate setae (cG, mG) and solenidion sigma (Fig. 21), femur I and II with one smooth seta, all legs with longitudinal granulated ridges (Figs. 20–21, 34).

4.1. Adults

4.1.1. Male

Body ovoid with truncated posterior end, anterior part elongated forming a tegmen covering the gnathosoma (Fig. 1), length of idiosoma between 170 µm and 180 µm, colour: brown.

Dorsum (Figs. 1, 3): Idiosomal chaetome: vi, ve, scx, si, se, c_1, c_2, c_p, d_1, d_2, e_1, e_2, h_1, h_2, f_2. – Ridges of honeycomb-like dome-shaped part decorated with small tubercles (see Fig. 24). All setae short.

Venter (Fig. 2, 9): Idiosomal chaetome: 1a, c_3, 3a, 3b, g, 4a, ps_1, ps_2, ps_3, h_3. – Gnathosoma with chelate chelicerae, palp tarsus with three button-like chetae distally and one dorsal filiform seta (Figs. 5–8).

Epimera I fused medially forming a sternum, epimera II–IV ending freely. Pattern of deep depressions in the body wall follows the course of leg apodemes underneath: depressions occur along the apodemes and at their medial end. Venter behind the gnathosoma a sclerotized plate with lobed margin, partly bordering the gnathosoma with a "collar" (Fig. 7). This "collar" bears two thin bifurcate elongations pointing at the gnathosoma and apparently constituting the Grandjean's organ (Figs. 5–7). Ventral plate with a soft walled region harbouring the aedeagus and another soft region around the anal slit (Fig. 10). All sclerotized regions covered with small bumps.

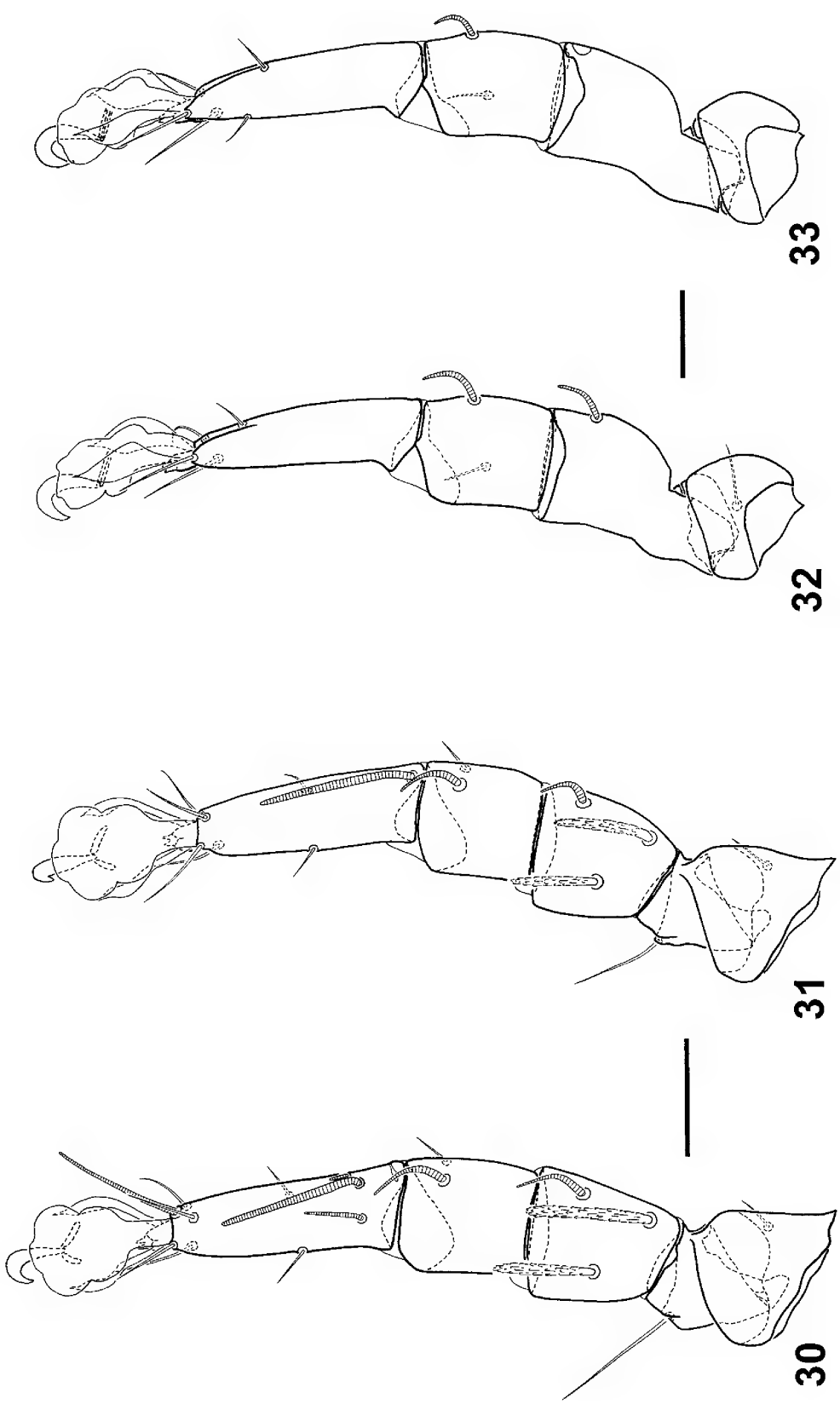
Aedeagus (Figs. 10–15) finger-like, the tip of it bends back and terminates in a shape like a duck bill. At each side a spike-like structure parallels the tip of the aedeagus.

Anal slit (Figs. 10–11, 13) situated in an area of soft cuticle forming a pillow. Lateral to the posterior end of the anal slit two spike-like lappets originate in this area.

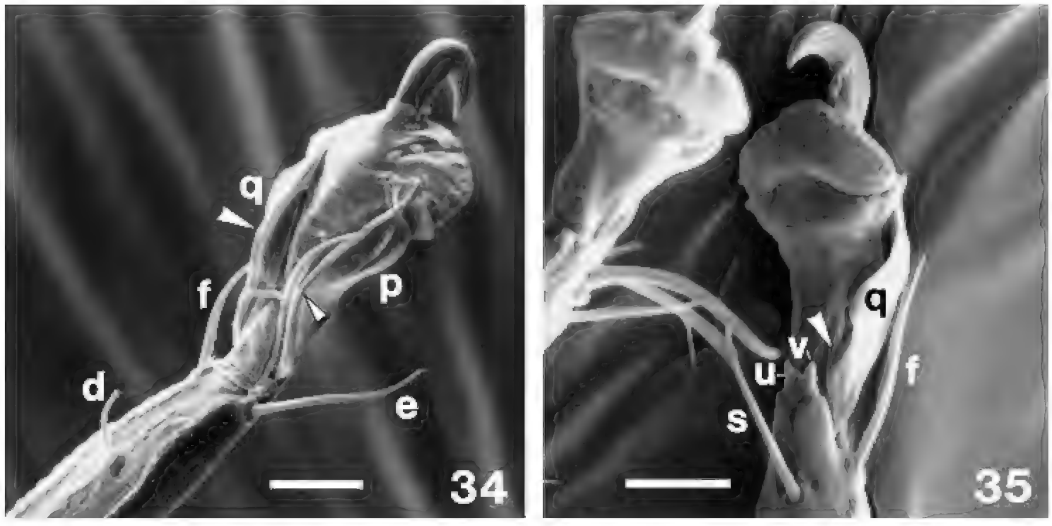
Legs (Figs. 16–21): Chaetome see Table 1. Solenidion omega 1 of tarsus II considerably larger than omega 1 of tarsus I (Figs. 16–17, 20).

4.1.2. Female

Body ovoid, anterior part forming a tegmen covering the gnathosoma (Fig. 23), length of idiosoma between 195 µm and 210 µm, colour: brown.



Figs. 30–33. *Lemanniella minotauri* n. sp., female. – 30. Leg I; – 31. leg II (scale bar Figs. 30–31: 15 µm); – 32. leg III; – 33. leg IV (scale bar Figs. 32–33: 10 µm). – Legs are shown in dorsal view.



Figs. 34–35. *Lemanniella minotauri* n. sp., female. – 34. Right leg III, dorsal view, showing leaf-like setae *p* and *q* which are adjacent to the pretarsus. The *arrowhead* points at the connection between the seta and the pretarsal cuticle. Note the granulated ridges on tarsus. Further *explications: d, e, f*: setae (scale bar: 5 µm); – 35. legs I showing the cuticular connection (*arrowhead*) between seta *q* and the pretarsus. Further *explications: u, v, f, s*: setae (scale bar: 5 µm).

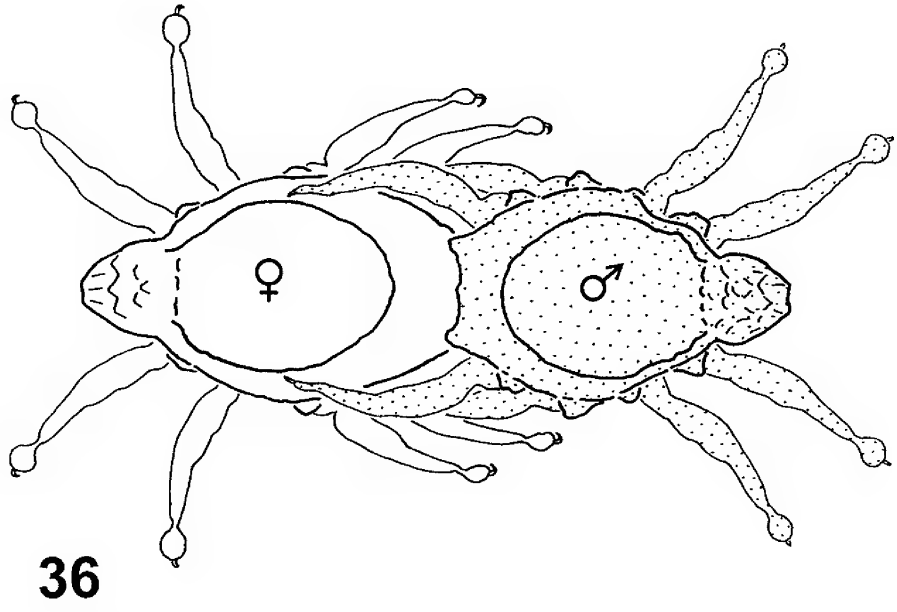
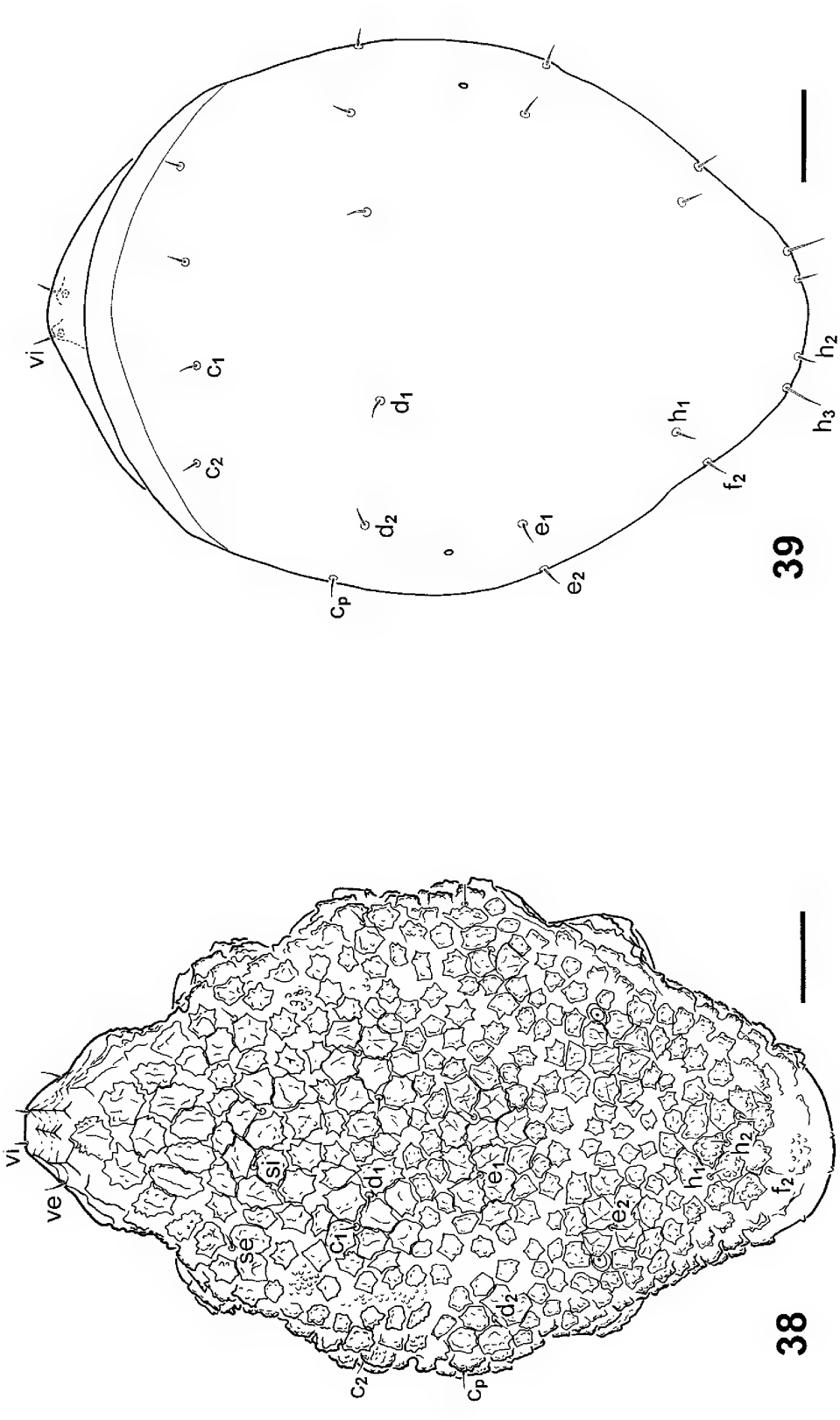
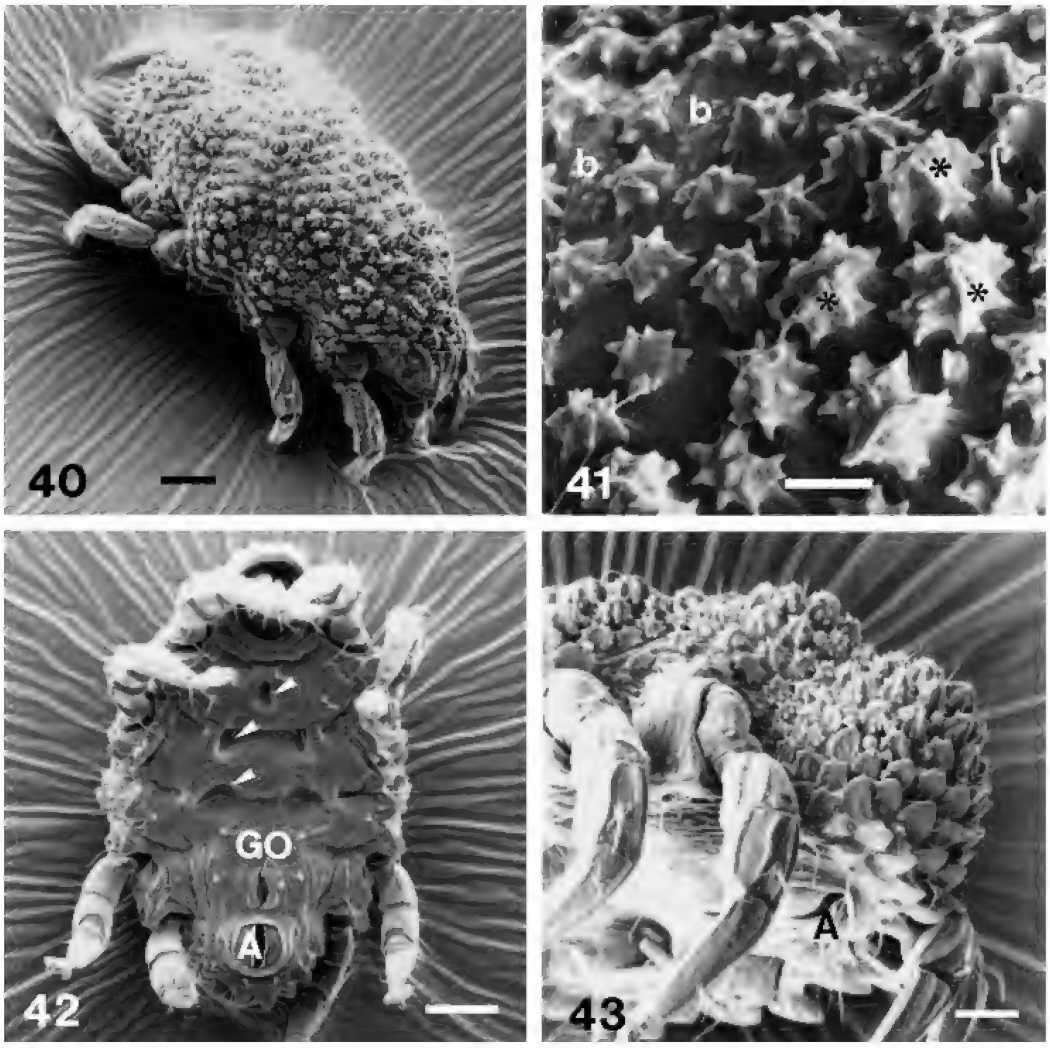


Fig. 36. *Lemanniella minotauri* n. sp.; mating position.

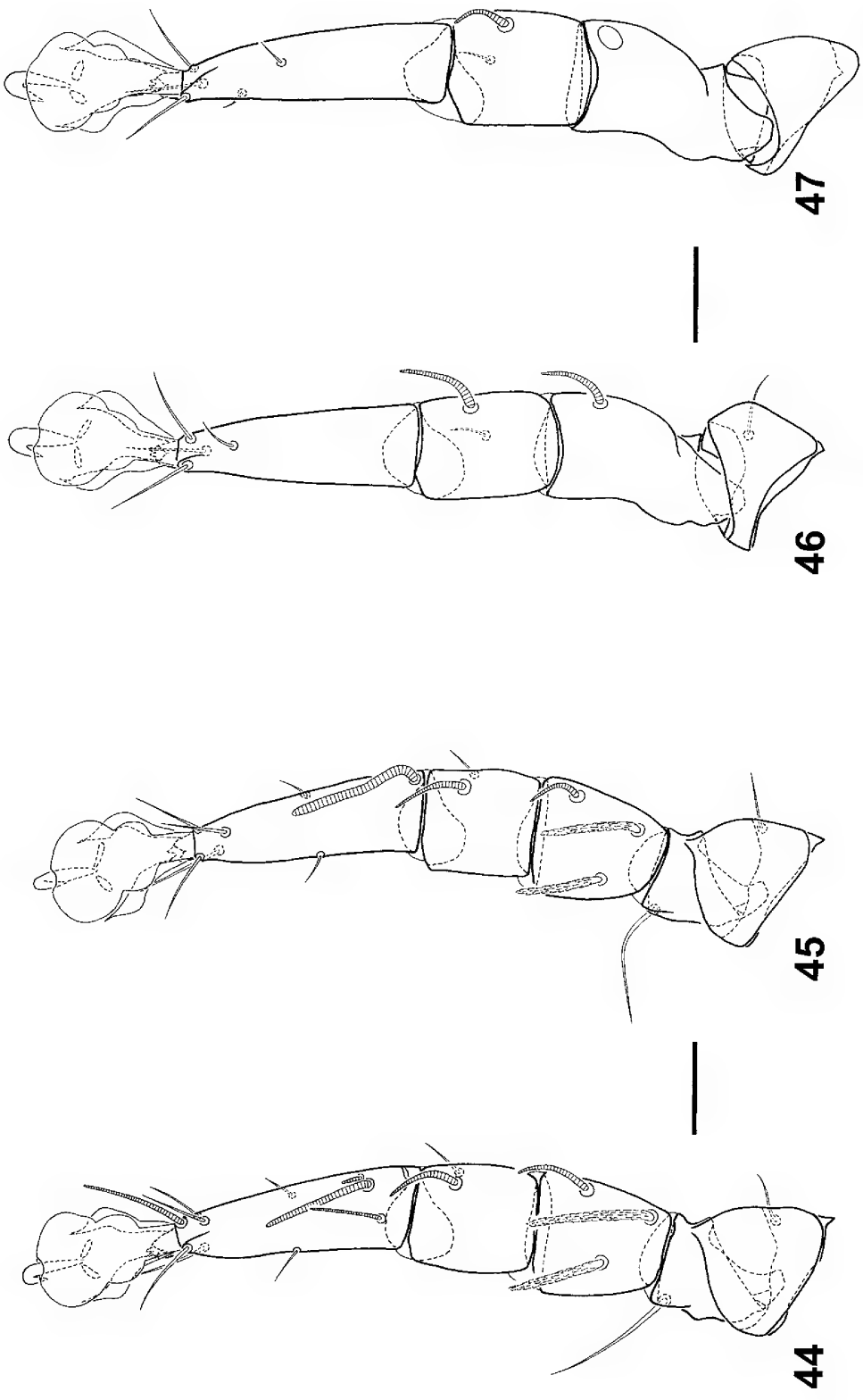
Fig. 37. *Lemanniella minotauri* n. sp., tritonymph; ventral view, left legs partly omitted. – Scale bar: 20 µm.



Figs. 38–39. *Lemanniella minotauri* n. sp. – 38. Tritonymph; idiosoma, dorsal view (scale bar: 20 µm); – 39. deutonymph; idiosoma, dorsal view (scale bar: 20 µm).



Figs. 40–43. *Lemanniella minotauri* n. sp., tritonymph. – 40. Dorsal view showing the distribution of the mushroom-like protuberances (scale bar: 20 µm); – 41. detail of dorsum showing the jagged protuberances (*asterisks*) and the patches of bumps (*b*) covering the surface (scale bar: 5 µm); – 42. ventral view of tritonymph showing the depressions (*arrowheads*) in the ventral body wall and the striated surface of cuticle; further *explications: A* = anal slit, *GO* = genital opening (scale bar: 20 µm); – 43. hysterosoma showing the gradual change of the jagged protuberances into scales; futher *explication: A* = anal slit (scale bar: 10 µm).



Figs. 44–47. *Lemanniella minotauri*, tritonymph. – 44. Leg. I; – 45. leg II (scale bar Figs. 44–45: 10 µm); – 46. leg III; – 47. leg IV (scale bar Figs. 46–47: 10 µm). – Legs are shown in dorsal view.

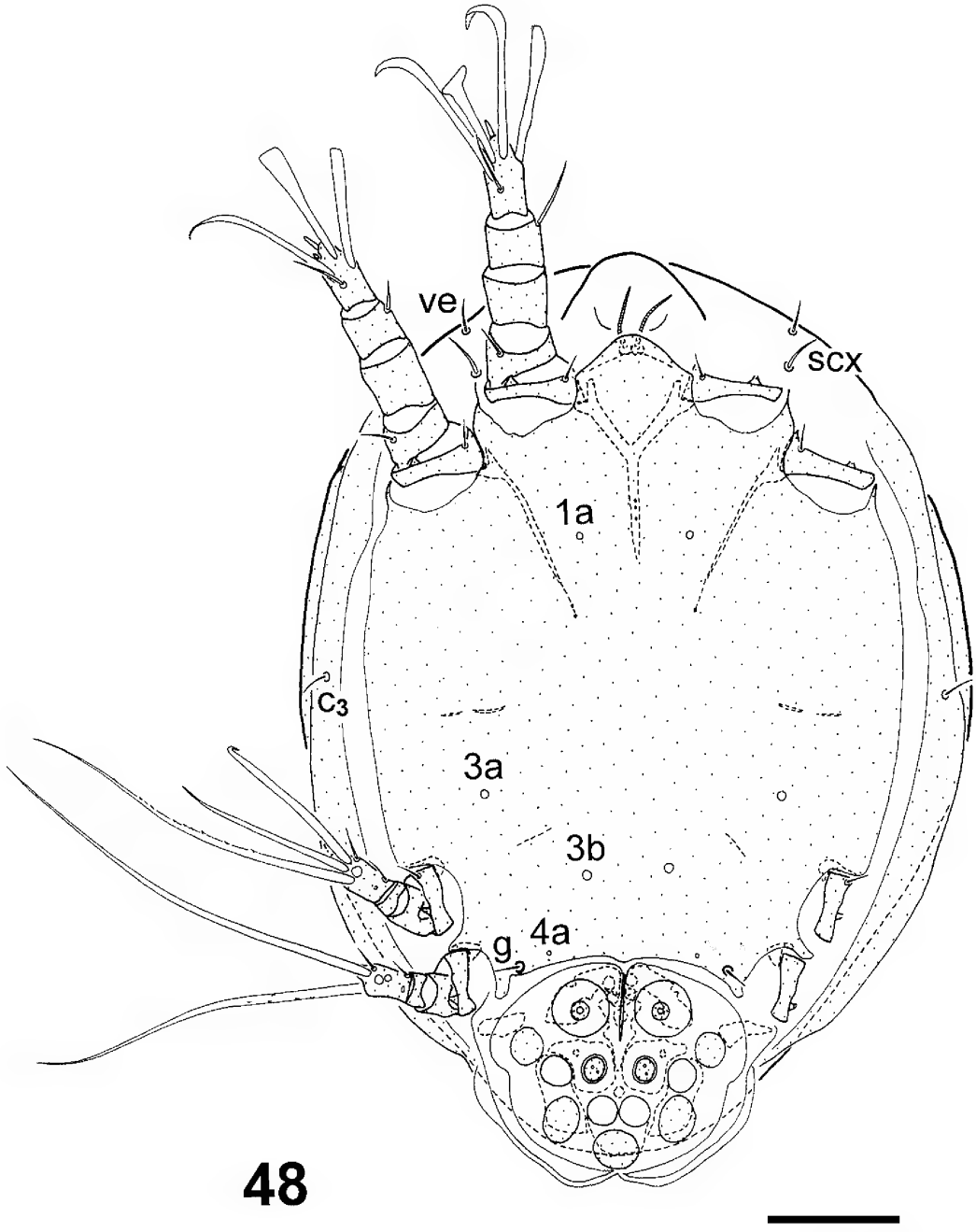


Fig. 48. *Lemanniella minotauri* n. sp., deutonymph; ventral view, left legs partly omitted. – Scale bar: 20 µm.

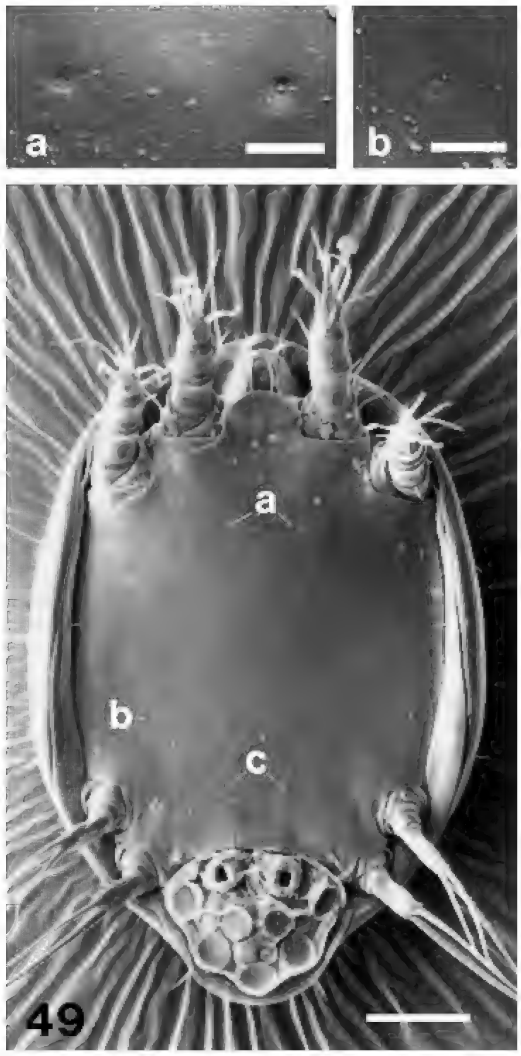
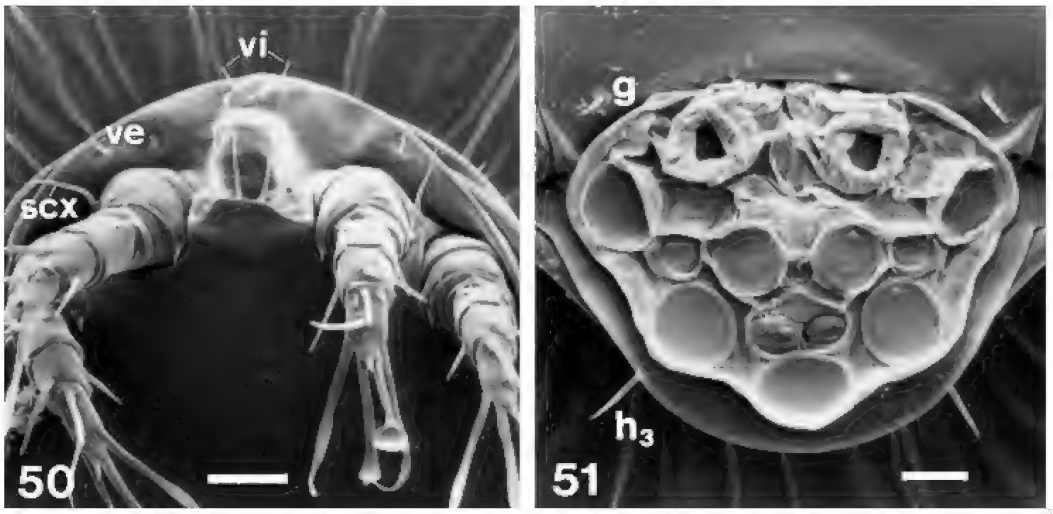


Fig. 49. *Lemanniella minotauri* n. sp., deutonymph; ventral view; *a, b,* and *c* refer to setae that are reduced to their sockets (see Fig. 48): *a*: setae 1a (scale bar inset: 5 µm), *b*: seta 3a (scale bar inset: 5 µm), *c*: setae 3b. – Scale bar: 20 µm.

Dorsum (Figs. 4, 23–24): Idiosomal chaetome: vi, ve, scx, si, se, c_1, c_2, c_p, d_1, d_2, e_1, e_2, h_1, h_2, f_2. – Otherwise as given for male.

Venter (Figs. 22, 26): Idiosomal chaetome: 1 a, c_3, 3a, 3b, g, 4a, ps_1, ps_2, ps_3, ad_1, ad_2, ad_3, h_3. – Gnathosoma (Fig. 25) as in male. With sclerotized ventral plate similar to the male but with one large soft-walled area encompassing the oviporus and the anal opening (genitoanal region) (Fig. 27). Arrangement of apodemes and depressions in the body wall as in male. With "collar" behind the gnathosoma as in male. The bumps cover only the area anterior to the oviporus.

Oviporus covered with a shield like a trapdoor (Fig. 26–28), with the "hinge" at its posterior end.



Figs. 50–51. *Lemanniella minotauri* n. sp., deutonymph. – 50. Proterosoma, ventral view showing the ventral position of setae *vi* and *ve*; further *explication: scx*: supracoxal seta (scale bar: 10 µm); – 51. the so-called sucker plate; *g*, h_3: setae (scale bar: 5 µm).

Bursa copulatrix (Fig. 28) a small slit without accessory structures situated at the hind end of opisthosoma. For receptaculum seminis see Fig. 29.

Legs (Figs. 30–35): Chaetome see Table 1.

4.2. Tritonymph

Body ellipsoid, anterior part forming a tegmen covering the gnathosoma (Fig. 40), if directly developed from protonymph length of idiosoma between 180 µm and 200 µm, colour: white.

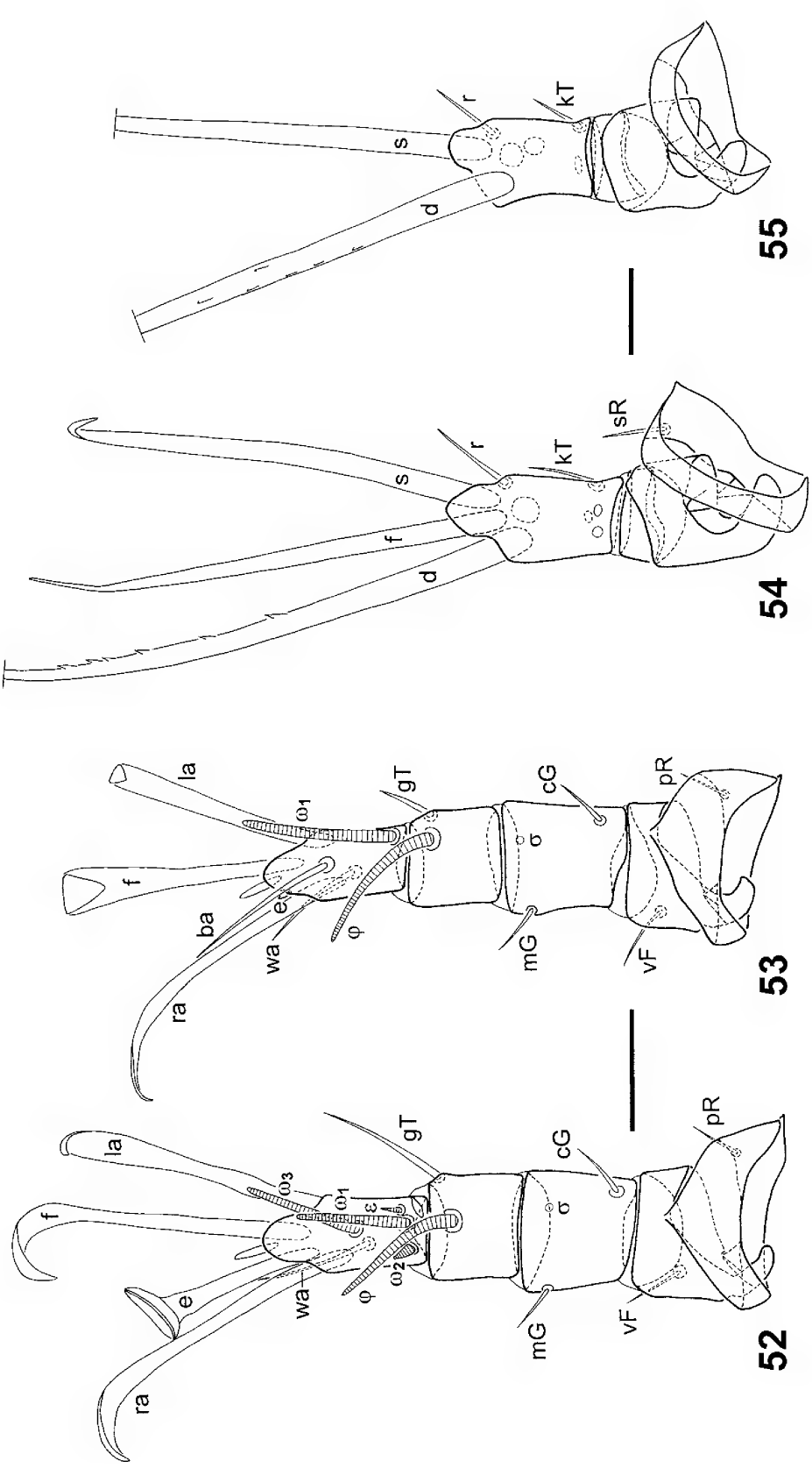
Dorsum (Figs. 38, 40): Idiosomal chaetome: vi, ve, scx, si, se, c_1, c_2, c_p, d_1, d_2, e_1, e_2, h_1, h_2, f_2. – Small patches of bumps dispersed between the jagged mushroom-like structures covering the surface (Fig. 41). The mushroom-like structures gradually change into scales laterally and posteriorly and into jagged ridges anteriorly (Fig. 43). All setae short.

Venter (Figs. 37, 42): Idiosomal chaetome: 1a, c_3, 3a, 3b, g, 4a, ps_1, ps_2, ps_3, h_3, – Gnathosoma as in male. Epimera I not fused, epimera II ending freely, epimera III and IV not discernible, with small sejugal apodemes. Pattern of depressions follows the arrangement of the apodemes. "Collar" behind the gnathosoma as in male. Genital and anal aperture anteriorly and posteriorly accompanied by sclerotized bands (Fig. 37). Entire surface striated and without bumps (Fig. 42).

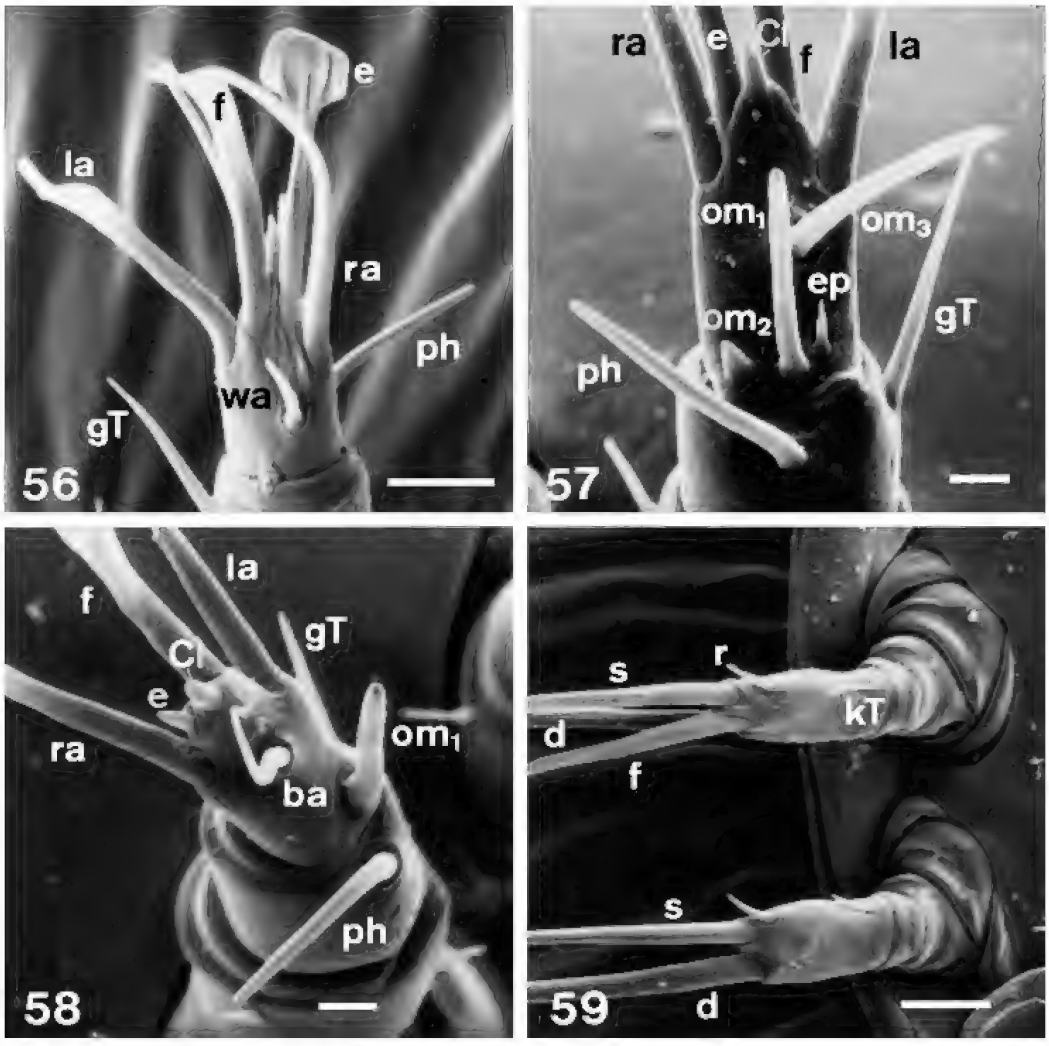
Legs (Figs. 44–47): Chaetome see Table 1.

4.3. Deutonymph

Body ovoid with tapered posterior end, length of idiosoma approximately 135 µm, colour: beige.



Figs. 52–55. *Lemanniella minotauri* n. sp., deutonymph. – 52. Leg I; – 53. leg II (scale bar Figs. 52–53: 10 µm); – 54. leg III; – 55. leg IV (scale bar Figs. 54–55: 5 µm). – Legs are shown in dorsal view.

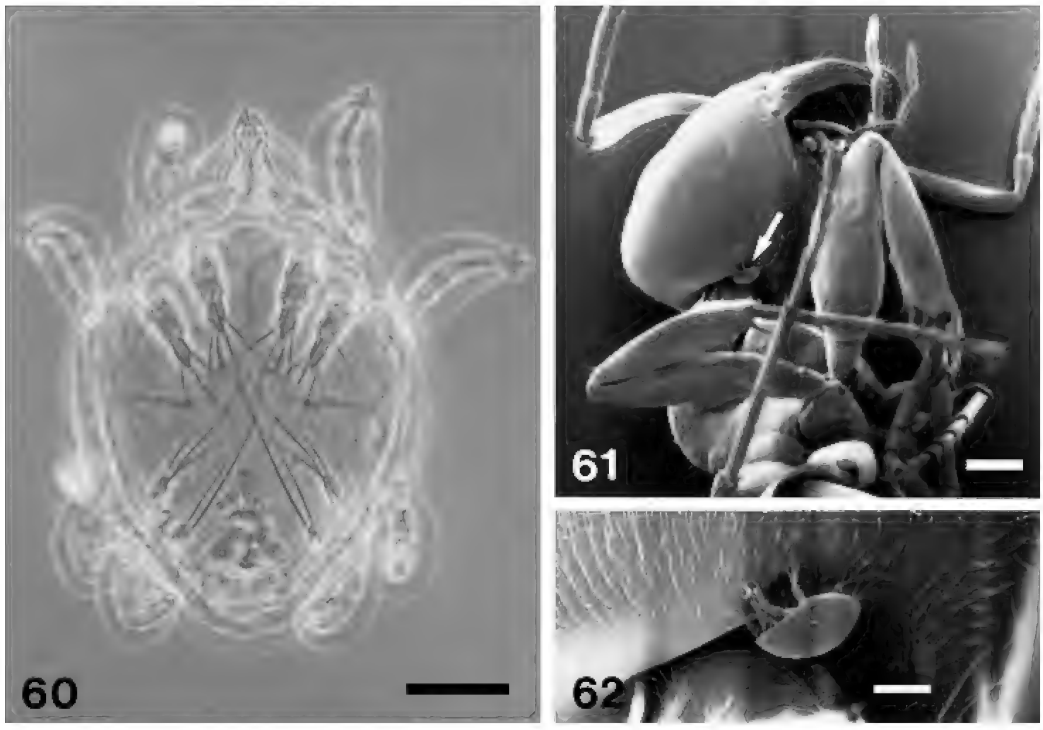


Figs. 56–59. *Lemanniella minotauri* n. sp., deutonymph. – 56. Left leg I, ventral view; *ph* = solenidion phi of tibia, *e, f, la, ra, wa, gT*: setae (scale bar: 5 µm); – 57. left leg I, dorsal view; *Cl* = sclaw, om_{1-3} = solenidion omega 1–3, *ph* = solenidion phi of tibia, *ep* = famulus epsilon, *e, f, la, ra, gT*: setae (scale bar: 2 µm); – 58. left leg II, apical view; *Cl* = claw, om_1 = solenidion omega 1, *ph* = solenidion phi of tibia, *e, f, ba, ra, la, gT*: setae. Note reduced seta *e* (scale bar: 2 µm); – 59. right legs III and IV; *d, f, s, r, kT*: setae (scale bar: 5 µm).

Dorsum (Fig. 39): Idiosomal chaetome: c_1, c_2, c_p, d_1, d_2, e_1, e_2, h_1, h_2, h_3, f_2.

Venter (Figs. 48–50, 60): Idiosomal chaetome: vi, ve, scx, c_3, g; setae 1a, 3a, 3b, 4a only as sockets. – Two palpal solenidia. Epimeres I fused medially forming a sternum, epimeres II ending freely, apodemes of leg III and IV strongly reduced. So-called sucker plate (Fig. 51) with complete set of modified setae, central "sucker" relatively small, the radius of it only half the radius of the anterior "sucker".

Legs (Figs. 52–59): Chaetome see Table 1. Tarsus I with spoon-like seta e, seta e of leg II reduced to a short spine, ra, la, f, leaflike, wa, ba, filiform. Solenidion sigma of genu I and II reduced, in SEM pictures only a small roundish depression is visible. In leg III and IV seta d very long and slightly pectinate.



Figs. 60–62. *Lemanniella minotauri* n. sp., deutonymph. – 60. Deutonymph enclosed in protonymphal exuvia, fixed immediately before hatching (light micrograph) (scale bar: 30 µm); – 61. anterior part of a worker ant of *Lasius brunneus* with deutonymph (*arrow*) attached to the ventral face of its head (scale bar: 200 µm); – 62. detail of Fig. 61 showing the attached deutonymph (scale bar: 50 µm).

4.4. Protonymph

Body ellipsoid, anterior part forming a tegmen covering the gnathosoma, length of idiosoma between 135 µm and 160 µm, colour: white.

Dorsum (Fig. 64): Idiosomal chaetome. vi, ve, scx, si, se, c_1, c_2, c_p, d_1, d_2, e_1, e_2, h_1, h_2, f_2. – As given for tritonymph but with lower density of mushroom-like structures.

Venter (Fig. 63): Idiosomal chaetome: 1a, c_3, 3b, g, ps_1, ps_2, ps_3, h_3. – As given for tritonymph.

Legs (Figs. 66–69): Chaetome see Table 1.

4.5. Larva and egg

Body ellipsoid, length of idiosoma between 90 µm and 110 µm, colour; white.

Dorsum (Fig. 65): Idiosomal chaetome: vi, ve, scx, si, se, c_1, c_2, c_p, d_1, d_2, e_1, e_2, h_1. – The mushroom-like structures are clustered in patches of five to ten elements each. The area between these patches is covered with numerous bumps. With cuticular scales at the flanks and at the opisthosomal end. All setae short.

Venter (Figs. 70, 74): Idiosomal chaetome: 1a, c_3, 3b, h_2. – Gnathosoma as in male. Epimera I not fused, epimera II ending freely, sejugal apodemes short. Body wall with only shallow depressions near the medial termination of the apodemes.

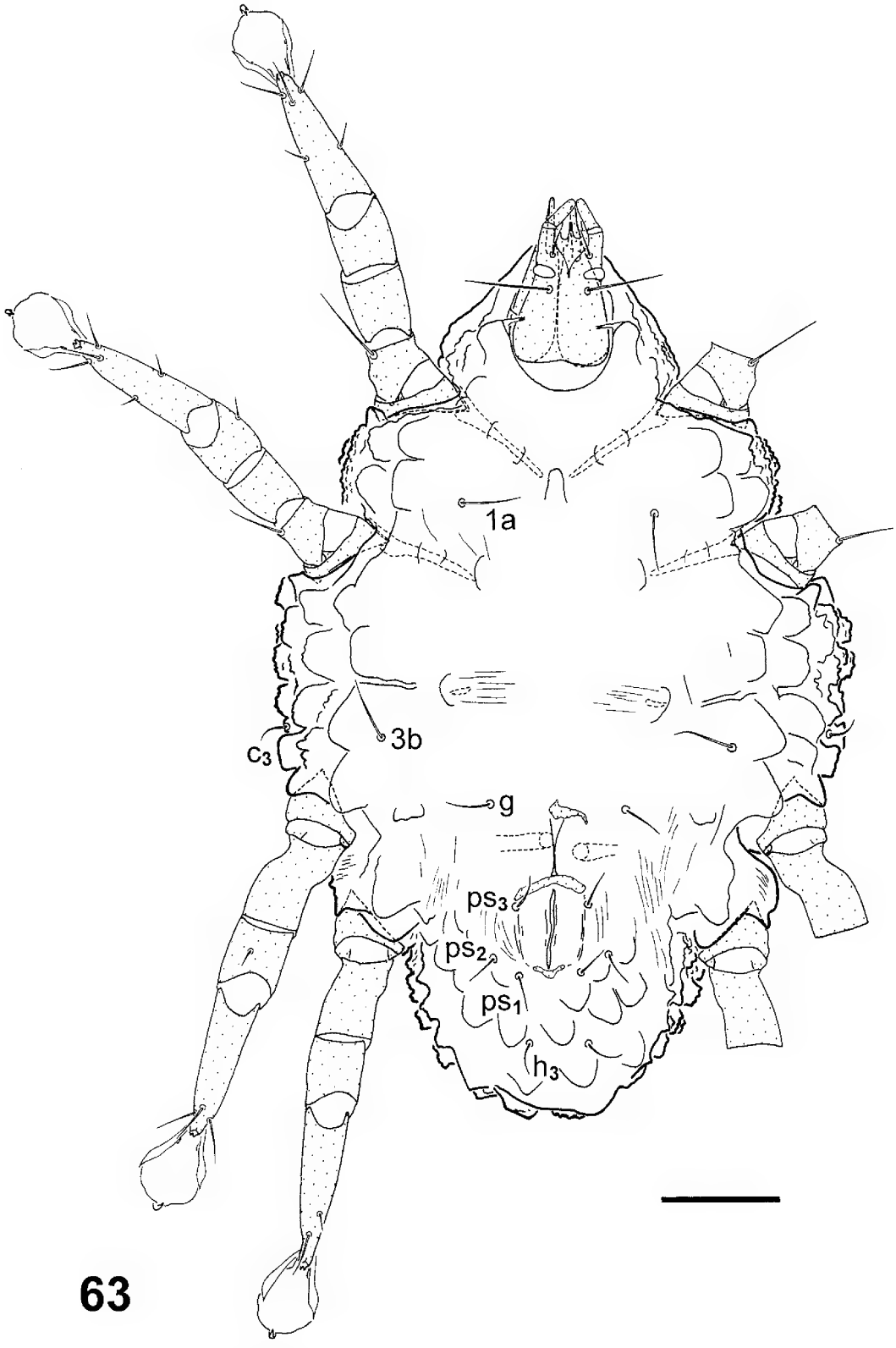
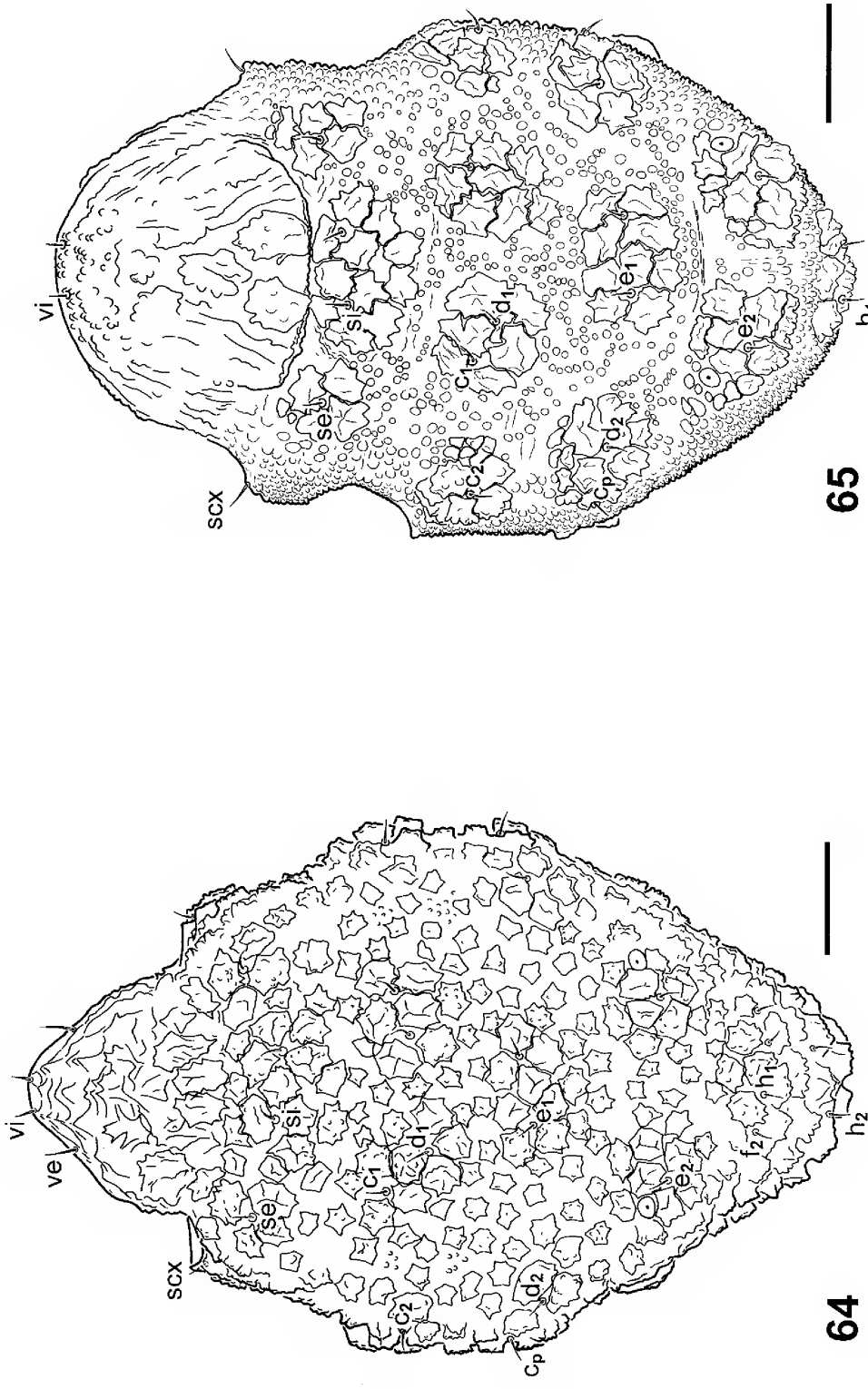
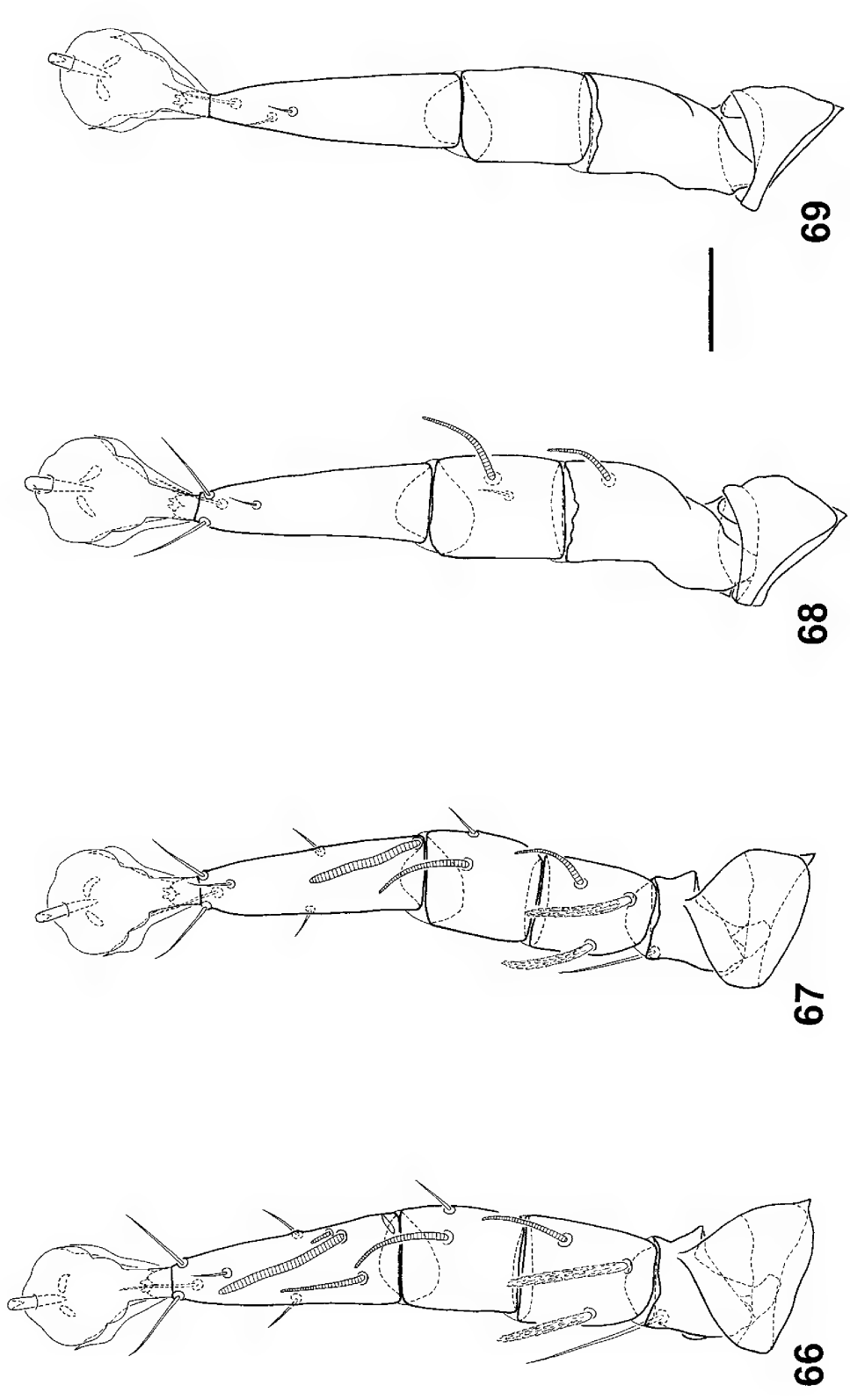


Fig. 63. *Lemanniella minotauri* n. sp., protonymph; ventral view, left legs partly omitted. – Scale bar: 20 µm.



Figs. 64–65. *Lemanniella minotauri* n. sp. – 64. Protonymph; idiosoma, dorsal view (scale bar: 20 µm); – 65. larva; idiosoma, dorsal view (scale bar: 15 µm).



Figs. 66–69. *Lemanniella minotauri* n. sp., protonymph. – 66. Leg I; – 67. leg II; – 68. leg III; – 69. leg IV. – Legs are shown in dorsal view (scale bar: 10 µm).

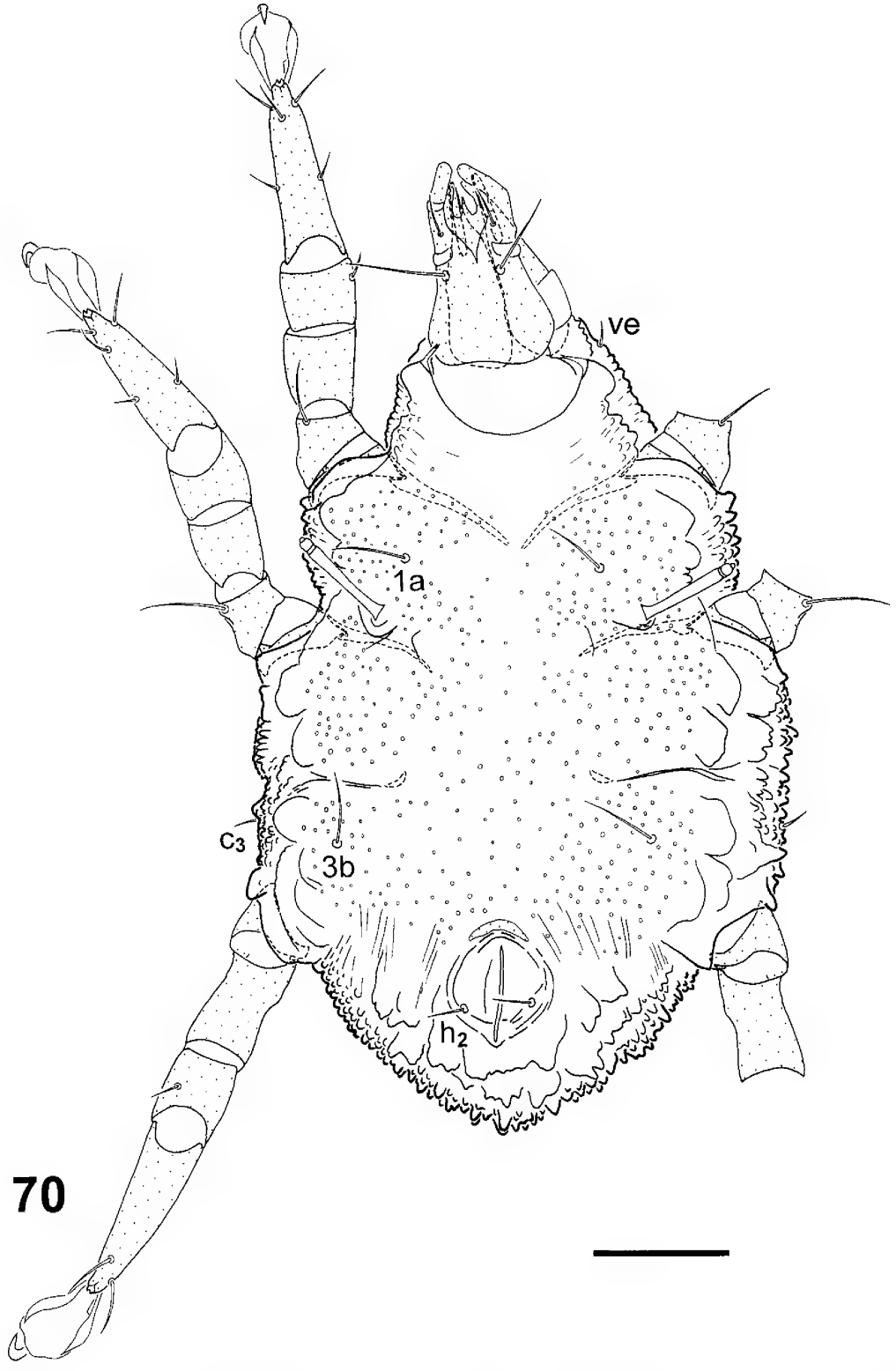
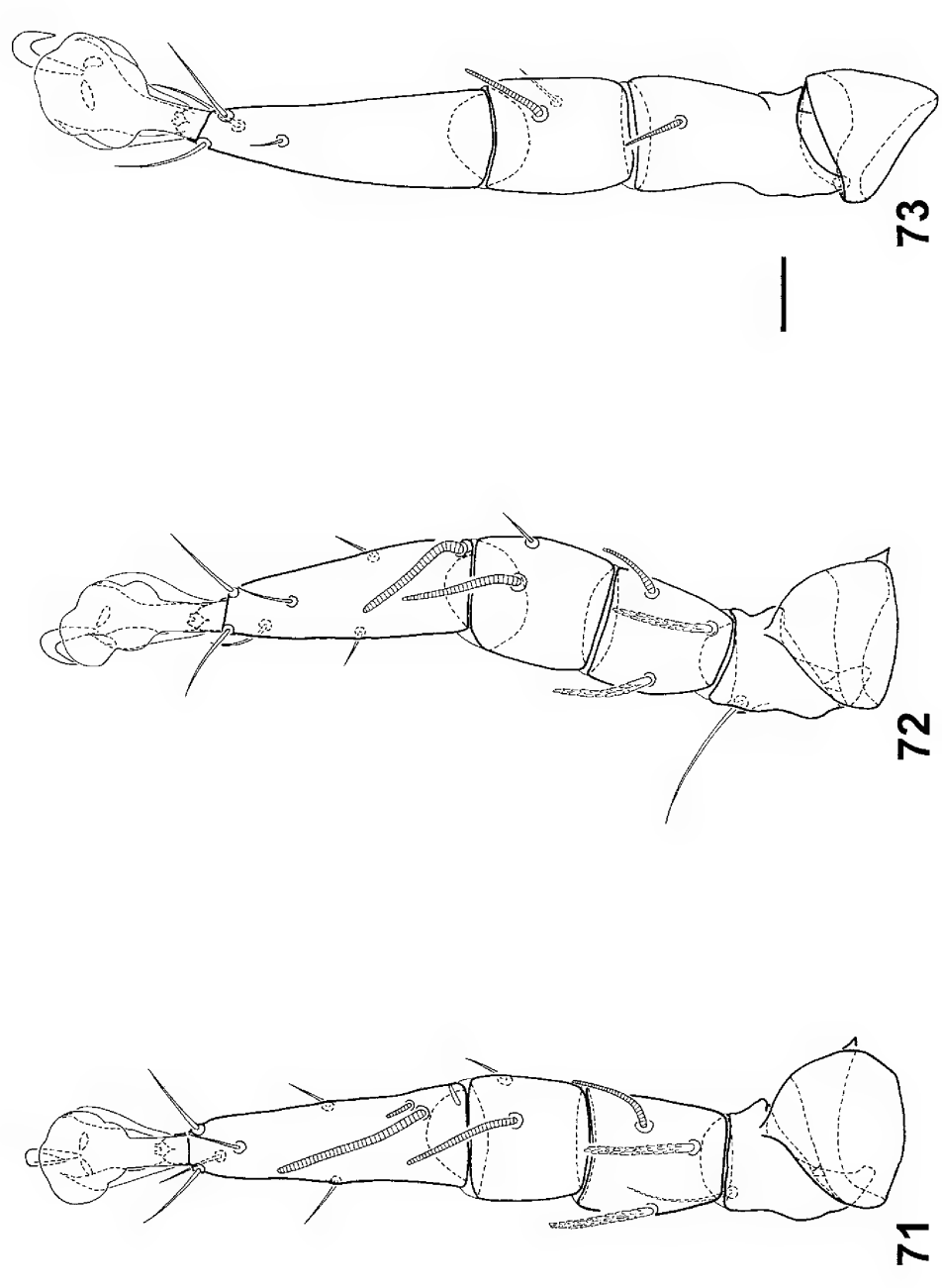
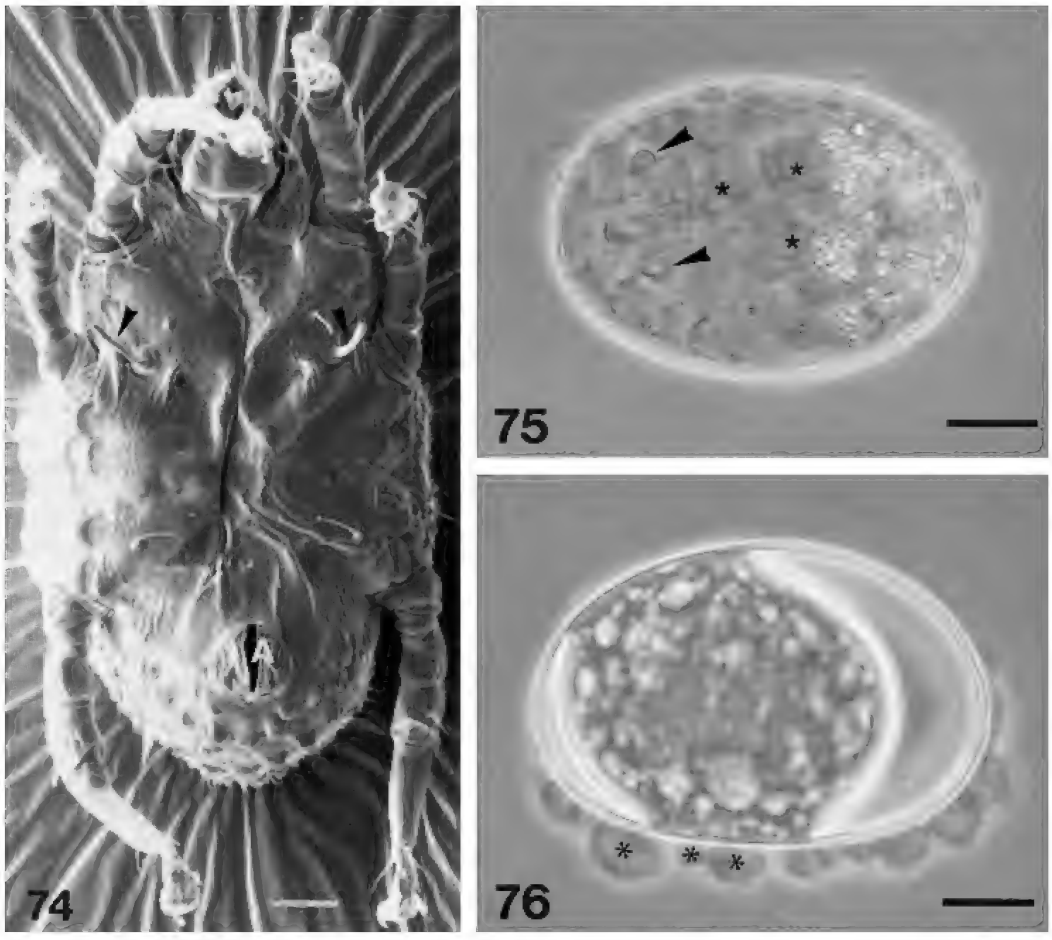


Fig. 70. *Lemanniella minotauri* n. sp., larva; ventral view, left legs partly omitted. – Scale bar: 15 µm.



Figs. 71–73. *Lemanniella minotauri* n. sp., larva. – 71. Leg I; – 72. leg II; – 73. leg III. – Legs are shown in dorsal view (scale bar: 5 µm).



Figs. 74–76. *Lemanniella minotauri* n. sp. – 74. Larva, ventral view. Note the shallow depression of the body wall and the covering of the surface with small bumps. *Arrowheads* point at Claparède organs. Further *explication: A* = anal slit (scale bar: 10 µm). – 75. Egg containing fully developed larva, dorsal view (light micrograph); *arrowheads*: prelarval bosses which are supposed to be necessary for hatching, *asterisks*: patches of jagged protuberances on the larval dorsum (scale bar: 20 µm). – 76. Egg (light micrograph). The globules (*asterisks*) cover only one half of the egg (scale bar: 20 µm).

"Collar" behind the gnathosoma as in male with sclerotized patch anterior to anal aperture. With long thin Claparède organs. Entire surface striated and covered with small bumps.

Legs (Figs. 71–73): Chaetome see Table 1.

Egg (Figs. 75–76): Length between 85 µm and 100 µm. One half of the egg is covered with globules of different sizes (Fig. 76).

5. Observations on the Biology of *L. minotauri* n. sp.

The mites feed on a small black fungus of an unidentified species growing on the wood in the ant nests.

Table 1. Chaetotactic formulae for setae and solenidia of the legs of *Lemanniella minotauri* n. sp.

Setae				
	leg I	leg II	leg III	leg IV
larva	10.1.2.1.0	10.1.2.1.0	8.1.0.0.0	–
protonymph	10.1.2.1.0	10.1.2.1.0	8.1.0.0.0	7.0.0.0.0
deutonymph	5.1.2.1.1	6.1.2.1.1	4.1.0.0.1	3.1.0.0.0
tritonymph	10.1.2.1.1	10.1.2.1.1	8.1.0.0.1	9.1.0.0.0
adults	10.1.2.1.1	10.1.2.1.1	8.1.0.0.1	9.1.0.0.0
Solenidia				
	leg I	leg II	leg III	leg IV
larva	1 + ε.1.1.0.0	1.1.1.0.0	0.1.1.0.0	–
protonymph	2 + ε.1.1.0.0	1.1.1.0.0	0.1.1.0.0	0.0.0.0.0
deutonymph	3 + ε.1.0.0.0	1.1.0.0.0	0.0.0.0.0	0.0.0.0.0
tritonymph	3 + ε.1.1.0.0	1.1.1.0.0	0.1.0.0.0	0.1.0.0.0
adults	3 + ε.1.1.0.0	1.1.1.0.0	0.1.0.0.0	0.1.0.0.0

Mating occurred in the retroconjugate mode (Fig. 36). In this position the enlarged and inflated region of the male anal region apparently serves as an attachment organ that helps in maintaining the connection with the female by adhesion. This might be supported by fluid discharged from the anus. If this interpretation of the role of the specialized male anal region is true, the question must be raised if the so-called adanal (or any other) suckers of astigmatic mites actually function as suckers (based on a pressure-difference principle and necessitating clean surfaces for the tightness) or rather as adhesive devices (based on the exploitation of surface forces and tolerating impurities on the surfaces involved).

The eggs were glued on the substrate by the globules covering one half of the egg.

Only a few of the inspected worker ants carried deutonymphs. In most cases only one deutonymph was attached, I never found more than two mites on one ant. As attachment site the deutonymphs preferred the head of the ant (Figs. 61–62). Here the hypopi were located at the posterior surface of the head or the ventral region of the head posterior to the mouth parts. In very rare cases deutonymphs were attached to the mesosoma.

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Author's address:

Dipl.-Biol. EBERHARD WURST, Institut für Zoologie (Fachgebiet Parasitologie), Universität Stuttgart, Emil-Wolff-Str. 34, D-70599 Stuttgart, F. R. Germany.

ISSN 0341-0145

Schriftleitung: Dr. Wolfgang Seeger, Rosenstein 1, D-70191 Stuttgart
Gesamtherstellung: Gulde-Druck GmbH, D-72072 Tübingen